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A Decision-Making Framework for Securing Compliant UCO Supply for SAF Production

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Abstract: PT Pertamina Patra Niaga (PPN) faces strategic challenges in sourcing qualified Used Cooking Oil (UCO) to meet Indonesia’s Sustainable Aviation Fuel (SAF) mandates. The government strictly enforces a 1% SAF blend by 2027 and 5% by 2029, pressuring PPN to secure a cost-effective and ISCC CORSIA-compliant supply chain. This study aims to evaluate four strategic alternatives: 100% "Make" UCO, 100% "Buy" UCO, 100% "Make" SAF Domestic, and "Partially Buy" SAF. A quantitative approach using the Analytic Hierarchy Process (AHP) was conducted, collecting primary data through questionnaires from the Board of Directors of PPN's Subholding Downstream. The findings reveal that executives heavily prioritize compliance objectives over short-term commercial gains. The AHP synthesis indicates that the 100% "Make" SAF Domestic strategy is the most optimal (36.2%), strongly supported by a 100% "Buy" UCO upstream model (31.3%). To mitigate supply chain risks and traceability fraud in the informal sector, this study recommends a digitally governed hybrid approach. This involves integrating blockchain traceability and establishing cross-institutional collaborations with the National Nutrition Agency (Badan Gizi Nasional). Ultimately, this framework provides a robust decision tool for establishing compliant and sustainable aviation fuel ecosystems in emerging markets.

Keywords: Analytic Hierarchy Process, Sourcing Strategy, Supply Chain, Used Cooking Oil, Sustainable Aviation Fuel.

INTRODUCTION

Reducing and controlling greenhouse gas emissions for the aviation sector sustainably and permanently has become an ever-increasing global priority due to the growing consequences of the industry's environmental footprint (Wandelt et al., 2025). With the global number of airline passengers expected to double to over 8 billion passengers per year by 2041, the aviation sector is projected to emit approximately 21.2 gigatons of CO2 by 2050. Recognizing the seriousness of this trajectory, the International Civil Aviation Organization (ICAO) has established the Net Zero Emission (NZE) 2050 target as a foremost priority, driven by the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and the

Long Term Global Aspirational Goal (LTAG) (Kementerian Koordinator Bidang Kemaritiman dan Investasi Republik Indonesia, 2024). As an archipelagic country consisting of thousands of islands, Indonesia’s aviation transport significantly supports its economy, with projected passenger growth reaching 390 million by 2037. The Indonesian market offers extraordinary potential for the development of Sustainable Aviation Fuel (SAF), possessing the capacity to produce 3.9 million tons of Used Cooking Oil (UCO) annually as of 2023, serving as a critical feedstock (Badan Riset dan Inovasi Nasional, 2025).

To accelerate the transition towards sustainable aviation, collaboration within the Pertamina Group, specifically PT Pertamina (Persero), PT Kilang Pertamina Internasional (KPI), PT Pertamina Patra Niaga (PPN), and PT Pelita Air Service (PAS), was established through the "Upstream-Downstream SAF Ecosystem Trial Collaboration". In this ecosystem, KPI handles the refinery operations, while PPN assumes the critical responsibility of acting as both the UCO aggregator and the SAF distributor. PPN operates an extensive domestic aviation business network, managing Aviation Fuel Terminals (AFT) across 63 airports divided into 8 marketing regionals nationwide. This massive operational scale places PPN at the forefront of Indonesia's aviation decarbonization efforts. Assuming Indonesia implements the proposed SAF blending targets, the domestic SAF demand is projected to experience significant growth, with the baseline scenario estimating total jet fuel demand to reach 15.8 million liters by 2060 (Kementerian Koordinator Bidang Kemaritiman dan Investasi Republik Indonesia, 2024).

To enforce this, the Ministry of Energy and Mineral Resources enacted Kepmen ESDM No. 113.K/EK.05/MEM.E/2026, which mandates strict timelines for blending SAF with conventional aviation fuel (Kementerian Energi dan Sumber Daya Mineral, 2026). The mandate strictly dictates a 1% SAF blending rate starting in 2027, rapidly escalating to 5% by 2029. To anticipate this exponential growth in SAF demand, evaluating alternative SAF production technologies such as Hydro-processed Esters and Fatty Acids (HEFA) is vital (Peters et al., 2023). Currently, HEFA technology using Palm Kernel Oil (PKO) creates sustainability issues, making it necessary to shift towards more environmentally friendly waste feedstocks like Palm Fatty Acid Distillate (PFAD) and Used Cooking Oil (UCO). However, the development of these alternative SAF production technologies requires massive investments, estimated at US$ 6.14 billion, to meet domestic SAF needs until 2060. A fundamental blocker to achieving these SAF production targets is the limited availability of sustainable feedstocks that meet rigorous international standards. With the establishment of the Cilacap and Plaju Green Refineries, Pertamina expects to reach a total SAF production capacity of 1,114 million liters from 2030 onwards (Kementerian Koordinator Bidang Kemaritiman dan Investasi Republik Indonesia, 2024). Nevertheless, securing the feedstock for these refineries poses an immense challenge. While Crude Palm Oil (CPO) is abundant, its emission reduction potential is marginal and fails to meet minimum global thresholds; PFAD has better emission reduction but limited availability; and UCO, which offers the best emission reduction potential, is severely challenged by fragmented collection networks and dominant export markets.

The physical distribution of SAF further complicates the ecosystem. PPN utilizes 11 Channels of Distribution (COD) to serve different airports. The highest air traffic is handled by COD 1 (serving Soekarno-Hatta/CGK) and COD 4 (serving I Gusti Ngurah Rai/DPS), accounting for 48.4% and 25.8% of traffic, respectively. Kepmen ESDM No. 113/2026 explicitly limits the initial SAF implementation to these two massive aviation hubs, creating a guaranteed captive market but simultaneously forcing an immediate, highly challenging upstream feedstock procurement requirement for PPN. The complexity of this ecosystem places PPN in a critical dilemma as an aggregator and supplier, forcing the company to navigate a "Make vs. Buy" strategic decision (Klein & Mazzoni, 2025). PPN acts as a UCO collector competing with private exporters, while simultaneously acting as a SAF supplier choosing between domestic refineries (KPI) and foreign overseas refineries. This dynamic creates intense tension between achieving national industrial goals and maintaining commercial efficiency while dealing with international auditors like ISCC CORSIA.

Therefore, the research objectives of this study are specifically designed to address these complex challenges. The first objective is to identify and analyze the critical success factors required for PPN to successfully implement a direct UCO collection ("Make") strategy. The second objective is to determine the operational requirements and challenges faced by PPN regarding the aggregation ("Buy") strategy for UCO from third-party collectors. The final objective is to develop a robust decision-making framework that supports PPN in balancing its commercial goals with national compliance mandates to ensure the security of a cost-effective and ISCC CORSIA-certified UCO-based SAF supply. The scope of this research is highly specific to the upstream supply chain practices of PPN concerning UCO and SAF, bounded geographically to the Indonesian archipelago, with a particular focus on the major hubs of Jakarta and Bali. The timeframe is directed at the preparedness for the 2027 mandate (1% blending) and scaling towards 2030. Furthermore, the study acknowledges significant organizational limitations due to recent corporate restructuring; specifically, the integration of PPN, KPI, and PIS into a unified "Subholding Downstream" with a bridging phase from February 2026 to October 2026, which necessitated targeting respondents exclusively at the Board of Directors level to avoid functional bias.

The international effort towards cleaner energy has placed the airline industry under immense pressure to develop sustainable substitutes for traditional jet fuel (Wandelt et al., 2025). Sustainable Aviation Fuel (SAF) from Used Cooking Oil (UCO) via the hydro-processed esters and fatty acids (HEFA) route is an industrially viable and technologically advanced process (Peters et al., 2023). However, the raw material must be rigorously pre-treated to remove water, free fatty acids, and impurities to prevent refining equipment damage and compromise to the final product (Cárdenas et al., 2021; Lopresto et al., 2024). The techno-economic reality indicates that SAF remains much more costly than traditional jet fuel due to the extremely high cost of the feedstock itself, which is exacerbated by aggressive competition from the renewable diesel market (Shahriar & Khanal, 2022; Wang et al., 2022). Despite these economic hurdles, life-cycle assessment (LCA) studies confirm that UCO-based SAF offers sizable greenhouse gas emission reductions ranging from 50% to 80% compared to fossil fuels, providing the primary ecological justification for its adoption (Yoo, Lee, & Wang, 2022).

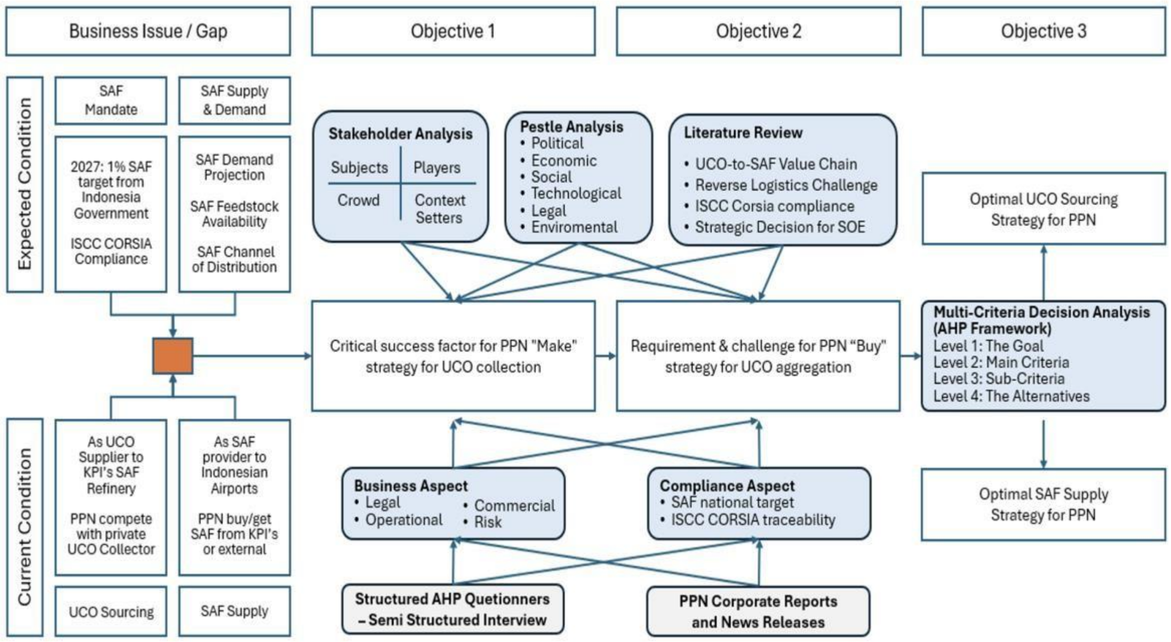
Supply chain management remains the most difficult component of the bio-aviation fuel ecosystem (Doliente et al., 2020). Unlike traditional forward logistics that distribute products from a central point of production to multiple consumption points, collecting UCO requires the exact opposite approach. It involves gathering a by-product from millions of scattered, unstructured points of origin, such as household kitchens and informal restaurants, and aggregating them into a single consumption point at the refinery. This necessitates a reverse logistics framework focused on collection, sorting, and disposition (Budijati et al., 2025). In Indonesia, this supply chain is highly fragmented, multi-leveled, and informal, meaning PPN cannot simply reverse its forward fuel distribution models but must design localized collection routes and sorting technologies.

To be internationally qualified and counted under Indonesia's SAF mandates, the supply chain must be certified under strict standards such as ISCC CORSIA. A critical vulnerability in this certification is proving the authenticity of the Point of Origin (PoO). The extremely high price of certified UCO creates strong incentives for fraud, such as the adulteration of waste oil or the fabrication of collection documents. Because chemical analyses cannot always distinguish genuine UCO from adulterated mixtures, the certification relies heavily on mass balance chain of custody audits. Consequently, conventional paper-based, self-declaration approaches are inadequate. Digital traceability platforms, utilizing blockchain and IoT to create transparent, immutable, geolocated, and timestamped digital ledgers, are no longer optional features but mandatory requirements for secure implementation (Gong et al., 2024).

The strategic dilemma faced by PPN is a classic "Make or Buy" scenario in supply chain management (Klein & Mazzoni, 2025; Seyedhosseini et al., 2012). The "Make" strategy involves developing capabilities through in-house direct UCO collection, while the "Buy" strategy involves acquiring the resource from third-party collectors, balancing logistical costs against transaction costs. However, as a State-Owned Enterprise (SOE) in an emerging economy, PPN's strategic decisions are rarely purely economic. SOEs are forced to balance corporate business interests with their role as state industrial policy agents (Lazzarini et al., 2020). Therefore, the optimal choice must balance multiple conflicting criteria, including national interest, strategic independence, and economic viability.

Multi-Criteria Decision Making (MCDM) techniques are utilized to assess alternatives against a multitude of conflicting criteria (Velasquez & Hester, 2013). MCDM aims to organize complex problems into a structured search for alternatives and confirm decisions made by a multiple-criteria approach (Xie et al., 2022). Various methods exist within this framework, such as Multi-Attribute Utility Theory (MAUT), Data Envelopment Analysis (DEA), and TOPSIS, each with its specific advantages and area of application ranging from supply chain management to corporate policy. Among MCDM methods, the Analytic Hierarchy Process (AHP), developed by Thomas L. Saaty in 1980, is highly effective for problems involving both qualitative and quantitative factors (Saaty, 1980). AHP decomposes complex issues into a multi-level hierarchical structure consisting of goals, criteria, sub-criteria, and alternatives. It utilizes pairwise comparisons to derive numerical weights based on the subjective judgments of decision-makers (Yang & Shi, 2002). This methodology ensures an integrated, mathematically sound evaluation to arrive at the most preferred strategic alternative.

The conceptual framework of this research outlines a structured journey from identifying the core business problem to formulating an optimal UCO sourcing strategy for PPN. It bridges the current condition, where PPN competes with private collectors and overseas refineries, to the expected condition of securing a cost-effective, ISCC CORSIA-compliant SAF supply to meet the 2027 government mandate. The analytical steps employ stakeholder analysis, PESTLE analysis, and MCDM using the AHP framework.



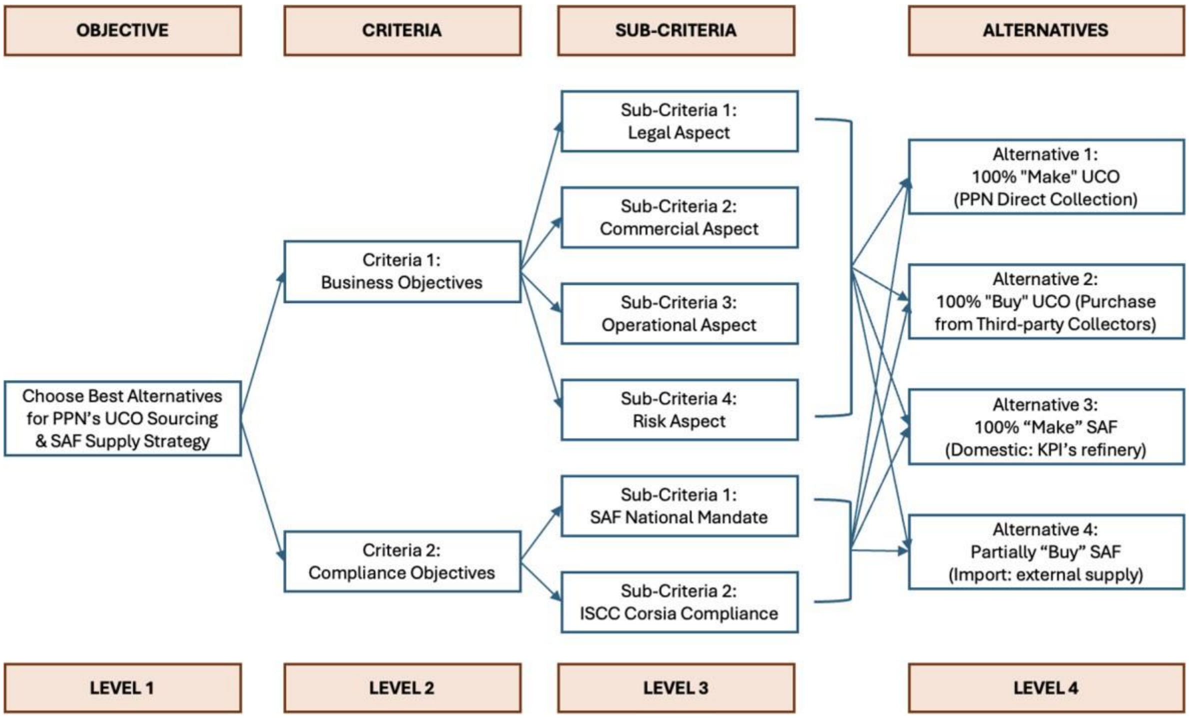
Source: Author Analysis

Figure 1. Conceptual Framework

METHOD

Research Design

This study utilizes a sequential mixed-methods design combining qualitative exploratory research with quantitative analysis to resolve the strategic sourcing dilemma faced by PT Pertamina Patra Niaga (PPN). This mixed-methods approach is crucial for balancing the qualitative nature of national industrial mandates with the quantitative goals required for developing the UCO-to-SAF ecosystem. The qualitative phase identifies the decision criteria and structures the business dilemma, which then serves as the foundation for the quantitative Analytic Hierarchy Process (AHP) to evaluate alternatives. The AHP hierarchy is broken down into four levels: Level 1 is the Goal (Optimal Sourcing and Supply Strategy); Level 2 consists of Main Criteria (Business Objectives and Compliance Objectives); Level 3 defines the Sub-Criteria (Legal, Commercial, Operational, Risk vs. SAF National Mandate, ISCC CORSIA Compliance); and Level 4 evaluates the four Strategic Alternatives (100% "Make" UCO, 100% "Buy" UCO, 100% "Make" SAF Domestic, and Partially "Buy" SAF Import).



Source: Author Analysis
Figure 2. Decision Value

Data Collection Method

Primary data were gathered through semi-structured interviews and a structured AHP questionnaire. Due to the massive corporate restructuring integrating PPN, KPI, and PIS into a unified Subholding Downstream (commencing February 1, 2026), the target respondents were strictly elevated to the Board of Directors level to capture a holistic corporate strategy and eliminate functional bias from merging departments. The carefully selected participants include the Director of Commercial (responsible for feedstock management and third-party contracts), the Director of Transformation, Digitalization & Sustainability (responsible for digital traceability strategies for ISCC CORSIA), and the Director of Corporate Marketing (responsible for aligning downstream B2B aviation fuel supply with the national mandate). Secondary data were collected through official government regulations, ISCC CORSIA documentation, corporate reports, and academic literature to build the foundational AHP hierarchy.

Table 1. Target Informants and Strategic Justification

No	Target Respondent	Functional Justification
1	Director of Commerce	Responsible for Feedstock Management, Trading, and Risk & Market Development. The director has authority over the pricing structure, economics of procurement, and contracts with third-party aggregators.
2	Director of Transformation, Digitalization & Sustainability	Directs the company's sustainability strategy and digital transformation strategy. This position is important in determining how PPN will use digital traceability systems to meet ISCC CORSIA requirements.
3	Director of Corporate Marketing	Oversees the Aviation Fuel Business and large-scale B2B industrial partnerships. This director represents the downstream demand side, ensuring the formulated upstream UCO strategy aligns perfectly with the 2027 SAF 1% national mandate.

Source: Author Analysis

Data Analysis Method

The data analysis was executed in two stages. First, a qualitative thematic content analysis was applied to secondary data to code relevant concepts into business and compliance objectives, constructing the four-level AHP hierarchy. Subsequently, the quantitative AHP analysis was conducted. The AHP methodology allows for the decomposition of complex, multi-objective problems into a measurable hierarchy. Participants evaluated the elements using pairwise comparisons based on Saaty's 9-point scale. Priority weights were calculated using eigenvalues, and the reliability of the executive judgments was strictly verified using the Consistency Ratio (CR). A CR of 0.10 or lower was required to ensure the logical transitivity of the judgments. The final synthesis of these weights determined the most optimal strategic alternative for the corporation.

RESULTS AND DISCUSSION

Stakeholder and PESTLE Analysis

A comprehensive stakeholder analysis was conducted to map the dynamics of the UCO-to-SAF ecosystem. PPN holds a unique and powerful position as the main gatekeeper, heavily involved in both UCO collection and SAF distribution. The Indonesian Government and Domestic SAF Refineries (KPI) are also central players. However, ISCC CORSIA acts as a highly influential context setter, holding absolute veto power over supply chain legitimacy despite having no commercial interest. Conversely, households and informal collectors are the ground-level subjects whose participation is crucial, yet they lack direct structural power. model cannot be strictly commercial but requires strategic policy and technological integration.

Table 2. Stakeholder Analysis

	Low Power	High Power
High Interest	SUBJECTS 1. **Households & Small Food Vendors:** Their participation is crucial for UCO supply, but do not have much power individually 2. **Informal UCO Collectors:** Their livelihood depends on the UCO trade, but they are fragmented. 3. **Environmental NGOs:** Highly interested in outcomes but have limited direct power over policy.	PLAYERS 1. **PT Pertamina Patra Niaga (PPN):** Main Gatekeeper. Is involved in UCO collection, SAF purchase, and operation of airport fuel to airlines. 2. **Domestic SAF Refinery:** Influenced by availability of raw materials and politically influential. 3. **Foreign SAF Refinery:**Market competitors and capable of selling SAF directly to airlines. 4. **Government (Ministries):** Establishes regulations that drive the market. 5. **Airlines:** End-users with substantial buying power.

Low Interest	CROWD 1. **Passengers:** Ultimately pay for SAF but have low direct interest and individual power. 2. **General Public:** Mostly unaware of specific UCO policies.	CONTEXT SETTERS 1. **ISCC CORSIA:** The standard setter that has complete power to legitimize supply chains. 2. **Airport Operators (Angkasa Pura):** Control access to infrastructure; have high power to enable the operations. 3. **Logistics Companies:** Provide essential networks; pricing sets boundaries.

Source: Author Analysis

PESTLE analysis further reveals that while the 2027 government mandate (Political) and circular economy goals (Environmental) act as strong tailwinds, the high costs of archipelago logistics (Economic), the challenge of shifting informal behaviors (Social), and the strict requirements for digital traceability (Technological and Legal) act as powerful headwinds. This proves PPN's business.

Table 3. PESTLE Analysis

Factor	Description & Implications for PPN
Political	Government Mandate The SAF blending mandate in 2027 is the main push factor, ensuring a market. However, political pressure to fast-track implementation may become the challenges due to the infrastructure development readiness. SOE Dominance PPN's involvement is politically driven, offering resources but also bureaucratic constraints.
Economic	High Collection Costs The archipelagic nature of Indonesia means that logistics for UCO collection will be costly. Price Volatility UCO feedstock prices vary due to competition from other industries (biodiesel) and the buying power of export market. "Green Premium" The price difference between SAF and standard jet fuel puts airlines in a tough spot without financial incentives.
Social	Behavioral Change The project will only succeed if millions of households adopt new behaviors to collect instead of discard their used oil. Informal Economy Incorporating the "minyak jelantah" informal sector poses social network issues, as well as livelihood protection for small-scale collectors.
Technological	Traceability Tech Digital applications and blockchain technology are key to ISCC certification but pose technological challenges for low-tech informal collectors. Refining Tech HEFA technology is established but pre-treatment of poor quality UCO is difficult for the refinery process.
Legal	ISCC CORSIA Standards International regulations serve as de facto law for access to the market. Failure to comply renders SAF unsellable to both domestic and international airlines. Waste Regulations National categorization of UCO as either waste or commodity determines how it is handled and exported.

Environmental	Circular Economy This project addresses the problem of domestic pollution (UCO dumping) and promotes green aviation. Lifecycle Emissions Optimization of logistics is required to avoid emissions from the collection process align the environmental benefits of SAF.

Source: Author Analysis

AHP Decision-Making Framework

PPN's governance dilemma was mathematically structured into the Analytic Hierarchy Process (AHP). The decision evaluated two main pillars: Business Objectives (broken into Legal, Commercial, Operational, and Risk sub-criteria) and Compliance Objectives (broken into SAF National Mandate and ISCC CORSIA Compliance). These were measured against four alternatives: Alternative 1 (100% "Make" UCO via direct collection), Alternative 2 (100% "Buy" UCO via third-party aggregators), Alternative 3 (100% "Make" SAF Domestic via KPI's refineries), and Alternative 4 (Partially "Buy" SAF via imports).

Table 4 Geometric Mean of Pairwise Comparison for Main Criteria

Criteria	Respondent 1	Respondent 2	Respondent 3	Geometric Mean
Compliance vs Business	0.33	1.00	1.00	0.693

Source: Research Result

Table 5 Detailed CR Calculation for Main Criteria

Main Criteria	Business	Compliance	Row Average	Weighted Sum	Average Value	λmax	CI	CR
Business	1.000	1.442	0.590	1.180	2.00	2.00	0.00	**0.00**
Compliance	0.693	1.000	0.410	0.820	2.00			

Source: Research Result

AHP Calculation Results and Consistency Test

The quantitative synthesis of executive judgments yielded highly consistent results, with all matrices passing the Consistency Ratio threshold (CR ≤ 0.10). Although executives felt intense commercial pressure initially, the derivation of global priority vectors revealed that ISCC CORSIA Compliance (weight 0.393) and SAF National Mandate (weight 0.244) heavily dominated the decision structure. When calculating the final performance, Alternative 3 (100% Make SAF Domestic) emerged as the preferred strategic solution with the highest global weight of 36.2%. This confirms the corporate commitment to utilizing domestic refinery assets. To support this downstream production, Alternative 2 (100% Buy UCO) ranked second at 31.3%, far outperforming the capital-intensive Alternative 1 (100% Make UCO) which scored only 17.7%. Alternative 4 (Partially "Buy" SAF Import) ranked last (14.8%) as it fundamentally contradicts the national energy independence mandate.

Table 6 Pairwise Comparison Matrix and Priority Vector of Sub-Criteria

Sub-Criteria	L	C	O	R	M	I	Priority Vector (Global Weight)
Legal (L)	1.00	0.33	2.00	0.25	0.20	0.14	0.048
Commercial (C)	3.00	1.00	4.00	0.33	0.33	0.20	0.096
Operational (O)	0.50	0.25	1.00	0.14	0.20	0.11	0.033
Risk (R)	4.00	3.00	7.00	1.00	0.50	0.33	0.186

Mandate (M)	5.00	3.00	5.00	2.00	1.00	0.50	0.244
ISCC (I)	7.00	5.00	9.00	3.00	2.00	1.00	0.393

Note: The global weights are derived by multiplying the local sub-criteria eigenvectors by their respective Main Criteria weights of Business [0.203] and Compliance [0.797]

Source: Research Result

Table 7 Detailed CR Calculation for Sub-Criteria

Sub-Criteria	L	C	O	R	M	I	Row Average	Weighted Sum	Average Value
Legal (L)	1.00	0.36	0.84	0.69	0.66	0.28	0.089	0.556	6.24
Commercial (C)	2.76	1.00	0.55	1.14	1.26	0.85	0.176	1.103	6.26
Operational (O)	1.18	1.82	1.00	1.36	0.79	0.46	0.158	1.002	6.34
Risk (R)	1.44	0.87	0.74	1.00	0.52	0.18	0.103	0.647	6.28
Mandate (M)	1.52	0.79	1.26	1.91	1.00	0.91	0.176	1.117	6.34
ISCC (I)	3.56	1.17	2.15	5.46	1.10	1.00	0.297	1.917	6.45

Calculation:

λmax = 37.91 / 6 = 6.318 CI = (6.318 – 6) / (6 – 1) = 0.064 CR = 0.064 / 1.24 = **0.051**

Source: Research Result

Table IV.7 Geometric Mean of Pairwise Comparison for Main Criteria

Alternative Solutions	Final Score	Percentage	Ranking
Alternative 3 (100% Make SAF Domestic)	0.362	36.2%	1
Alternative 2 (100% Buy UCO)	0.313	31.3%	2
Alternative 1 (100% Make UCO)	0.177	17.7%	3
Alternative 4 (Partially Buy SAF Import)	0.148	14.8%	4

Source: Research Result

Strategic Implementation and Discussion

The mathematical results of the AHP dictate a hybrid ecosystem strategy: PPN must prioritize domestic refining while acting as an apex aggregator that "buys" bulk UCO but applies "make"-type digital controls to secure the supply chain. To successfully execute this and mitigate the high risks of ISCC CORSIA mass-balance audit failures, a novel strategic implementation plan is required. PPN must deploy a mandatory technological gateway (blockchain/IoT) where third-party collectors cannot transact without recording verifiable Point of Origin data (Gong et al., 2024). Furthermore, to secure massive feedstock volumes against export competition, PPN must form a strategic cross-institutional collaboration.

This involves signing a Memorandum of Understanding (MoU) to absorb UCO directly from the Satuan Pelayanan Pemenuhan Gizi (SPPG) under the National Nutrition Agency's (Badan Gizi Nasional) Free Nutritious Meal (Makan Bergizi Gratis) program (KumparanBisnis, 2026), supported by grassroots networks like GAPULIMGI (Pertamina, 2026). The collected feedstock will be channeled to the RU IV Cilacap refinery, with the finished SAF distributed exclusively to COD 1 (CGK) and COD 4 (DPS) to strictly fulfill the 1% target of Kepmen ESDM No. 113/2026 by 2027.

Table 9. SAF Ecosystem Development Milestone

Achieved Milestone	
2015	Catalyst Development Research Phase
2018	Catalyst Isomerization Trial on ITB's APU
2020	Bio-Jet fuel J2.4 Prototype Trial on GMF's Test Cell
2021	J2.4 Fuel Flight Test CN235 Aircraft Dirgantara Indonesia
2023	J2.4 Fuel 1st Commercial Flight Garuda's B737 CGK-SOC vv
2024	SAF Market Commercialization Bali International Airshow
2025	Indonesia's SAF Ecosystem Expansion Product of Pertamina's Cilacap Refinery
Recently Achieved Milestone	
2026	Pertamina and GAPULIMGI build a national sustainable UCO ecosystem involving the community
2026	Pertamina and BGN synergize UCO into low-carbon aviation energy
Proposed Milestone Preparation & Target	
Q3/2026	Finalize commercial UCO off-take agreements and deploy digital ISCC CORSIA traceability
Q4/2026	Delivery of UCO to RU IV Cilacap for SAF production
	SAF Production in RU IV Cilacap
	Delivery of SAF to Soekarno Hatta (CGK) & Ngurah Rai (DPS)
	Finalize commercial SAF agreement with airlines
	Delivery of SAF to airlines and conduct ceremony for the 1st official SAF supply
Q1/2027	Commence full-scale continuous SAF supply to airlines to strictly fulfill the 1% mandate (28,000 KL UCO equivalent) at CGK and DPS
Q2/2027	Conduct internal evaluation of Q1 supply chain performance and optimize BGN/GAPULIMGI logistics routes
Q3/2027	Perform comprehensive ISCC CORSIA mass-balance audits and digital ledger reconciliation
Q4/2027	Finalize 2027 performance reviews and lock in expanded UCO volume contracts for 2028
2028	Maintain 1% SAF Mandate compliance while executing infrastructure and procurement expansion to prepare for the 5% mandate leap
2029	Execute the 5% SAF mandate, supplying scaled-up SAF volumes to CGK and DPS
2030	Sustain 5% SAF mandate compliance while strategizing and testing expanded capacities for potential higher government-regulated SAF blending mandates

CONCLUSION

The critical success factors for implementing a direct UCO collection ("Make") strategy by PT Pertamina Patra Niaga rely on maintaining ultimate control over reverse logistics and micro-level storage facilities. While this approach ensures perfect chain of custody and absolute ISCC CORSIA compliance, it is rendered unfeasible at a 100% scale due to the enormous capital expenditures required to navigate Indonesia's archipelagic geography. Conversely, the operational challenge of the "Buy" strategy—aggregating UCO from third parties—lies in severe compliance vulnerabilities, specifically the risk of virgin palm oil contamination and the lack of digital traceability in the informal sector, compounded by intense price volatility driven by lucrative European export benchmarks. Synthesizing these realities through the Analytic Hierarchy Process, the optimal decision-making framework demonstrates that corporate strategy must heavily prioritize compliance objectives over short-term commercial gains. The mathematical modeling firmly rejects the importation of SAF, selecting 100% "Make" SAF Domestic as the primary downstream strategy. To supply this capability, the framework favors purchasing bulk volumes (100% "Buy" UCO) over building a direct collection network.

Therefore, PPN must adopt a digitally governed hybrid approach. To secure this ecosystem and align with Kepmen ESDM No. 113.K/EK.05/MEM.E/2026, management must immediately deploy mandatory blockchain or IoT traceability ledgers for all incoming feedstocks to prevent mass-balance audit failures. Concurrently, PPN must forge strategic collaborations with the National Nutrition Agency (Badan Gizi Nasional) and community networks like GAPULIMGI to secure a massive, traceable domestic feedstock stream from the national free meal program. By executing long-term retention contracts with dynamic pricing and strictly targeting SAF distribution to Soekarno-Hatta and I Gusti Ngurah Rai airports, PPN can efficiently achieve the 1% mandate by 2027 while preparing for the 5% escalation in 2029. Future research should explore the techno-economic integration of advanced pre-treatment units for informal UCO and incorporate predictive analytics to forecast long-term commodity pricing dynamics.

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