

Integrated Supply Chain Management and Fuel Security in the Lao PDR

Sivilay Keobountham

Faculty of Social Sciences, National University of Laos, Vientiane Capital, Lao PDR
Email: sivilaykt@gmail.com

How to cite this paper: Keobountham, S. (2026). Integrated Supply Chain Management and Fuel Security in the Lao PDR. *Open Journal of Social Sciences*, 14, 552-566.

<https://doi.org/10.4236/jss.2026.1410026>

Received: September 8, 2026

Accepted: October 25, 2026

Published: October 28, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

This study aims to: 1) examine the key challenges in the fuel supply chain management system in the Lao PDR; and 2) propose appropriate guidelines and strategies to ensure the security and sustainability of the country's fuel supply chain. Employing a qualitative research design, the study utilized purposive sampling to select 19 key informants, comprising policy-level administrators, legal experts, fuel business operators (importers and distributors), and representatives from fuel associations. Data were collected through structured interviews and open-ended questionnaires, and subsequently analyzed using descriptive content analysis. The investigation integrated three conceptual frameworks—the 4As, Triple-A, and ISCM—alongside an analysis of regulatory frameworks, notably the Decree on Fuel Business (No. 559/PM). The findings reveal that the country's complete reliance on fuel imports routed through neighboring countries creates severe vulnerabilities. These are driven by foreign exchange liquidity crises, high land transportation costs, limited strategic reserves, distribution imbalances in remote areas, and a lack of data integration between the public and private sectors. To foster supply chain resilience, the study recommends five strategic measures: 1) diversifying import sources through multimodal transport and an electronic customs clearance system (e-Customs); 2) implementing a cost-reflective pricing structure supported by financial cushioning mechanisms; 3) enforcing a 30-to-45-day fuel reserve mandate via public-private partnership (PPP); 4) utilizing a centralized digital platform for demand forecasting; and 5) accelerating the transition toward clean energy while promoting transparent public-private dialogue (PPD).

Keywords

Management, Integrated Supply, Chain, Fuel Security, Lao PDR

1. Introduction

Energy serves as the lifeblood of the global economy, with fuel acting as an indispensable factor of production and logistics. However, geopolitical fluctuations and global market instability have continuously threatened energy security. Globally and regionally, integrated supply chain management (ISCM) from upstream to downstream, alongside the establishment of National Strategic Petroleum Reserve (NSPR), has been elevated as a crucial mechanism for building resilience against such energy crises. In the Lao People's Democratic Republic (Lao PDR), despite its potential in electricity generation, the petroleum sector remains structurally vulnerable in terms of pricing and security due to a complete reliance on refined fuel imports routed through neighboring countries—a situation underscored by import volumes totaling 6,515,027,974 liters between 2022 and 2025 (Department of Standards and Metrology, 2025; Domestic Trade Department, 2026).

Currently, the country's fuel supply structure is driven by 11 major companies officially authorized for import and export, alongside 14 domestic fuel distribution companies. Import routes predominantly pass through Thailand, supplemented by the expansion of strategic corridors such as imports via Nghi Son Port (Vietnam) through the Namkan and Namsoi international checkpoints, as well as the Boten checkpoint for northern provinces. However, between 2021 and 2026, the Lao PDR has faced compounded crises, including periodic fuel shortages, exchange rate volatility, liquidity pressures stemming from Public Service Obligations (PSO) borne by the Lao State Fuel Enterprise (LSFE) (Xaysongkham, 2026), and limited reserve capacities. These conditions indicate that the Fuel Supply Chain (FSC) still lacks full integration and remains vulnerable to shocks, triggering cascading effects on the macroeconomy and public livelihoods.

Given these circumstances, this study holds profound significance for both theoretical development and policy formulation, serving as a robust empirical foundation for crafting macroeconomic strategies, developing energy infrastructure, and upgrading fuel supply chain management mechanisms to ensure security, stability, and sustainability. To derive scientific strategic guidelines tailored to the context of the Lao PDR, this study establishes a comprehensive analytical framework by integrating Integrated Supply Chain Management (ISCM), Triple-A capabilities (Agility, Adaptability, Alignment), and the core dimensions of energy security (the 4As: Availability, Accessibility, Affordability, and Acceptability). Consequently, the research addresses three core questions: 1) Under current import constraints, what is the status of fuel security in the Lao PDR across the 4As, and what are the critical turning points? 2) How can the existing supply chain structure be upgraded through supply chain integration and Triple-A capabilities to mitigate systemic vulnerabilities? and 3) What measures and strategies are most effective in accommodating the projected continuous increase in fuel demand for the 2026-2030 period?

2. Literature Review

2.1. Supply Chain and Value Chain Management in the Energy Industry

Supply Chain Management (SCM) has evolved from traditional operational management processes—focused merely on material movement and inventory control—toward “strategic business process integration” across organizational networks from upstream to downstream (Oliver, 1982). This concept is complemented by Michael Porter’s Value Chain Theory, which indicates that all organizational activities—whether primary activities or support activities—incur costs that can generate value creation for goods and services (Porter, 1985). When synthesizing these two concepts, value chain analysis serves as an in-depth analytical tool to identify activities that generate maximum value in order to achieve a competitive advantage through cost leadership or differentiation strategies.

In the dimension of the energy and fuel industry, the SCM framework plays a prominent role through integration across the entire value chain: 1) upstream activities cover procurement, trade negotiations, and crude oil imports; 2) mid-stream activities involve cross-border transportation, international logistics management, and storage systems at strategic reserves; and 3) downstream activities refer to distribution and the management of fuel service station networks to effectively reach distribution outlets (end consumers) (Lambert, 2014). However, the current business environment, fraught with uncertainty, requires SCM to transition from a sole focus on cost efficiency toward building a dynamic supply chain and enhancing resilience (Burrows & Gattorna, 2008). Therefore, the SCM framework is critically important to the study of energy security, as the fuel supply chain must possess the capability to swiftly, flexibly, and securely absorb shocks from global crises, energy market price fluctuations, and geopolitical risks.

2.2. Integrated Supply Chain Management (ISCM)

Supply chain analysis is rooted in the Value Chain concept, which serves as a fundamental framework for exploring and evaluating business activities from upstream to downstream (Porter, 1985). Although this concept primarily focuses on the competitive advantage dimension at the organizational level (Mentzer et al, 2001), it has been further extended to strategic coordination that transcends traditional business functions—both within the organization and among partner networks—to enhance long-term efficiency. When examining operational levels closely, the success of such coordination is driven through the integration of 8 key business processes (Lambert & Cooper, 2000)—for example, customer relationship management, service management, demand management, and procurement. Supply chain literature indicates that the lack of transparent and real-time information sharing often triggers the “Bullwhip Effect,” where minor fluctuations in customer demand at the downstream end are amplified in severity as they propagate upward toward the upstream level (Forrester, 1961).

Consequently, the ISCM concept addresses this issue by establishing a Single

Point of Truth through the utilization of Enterprise Resource Planning (ERP) systems to reduce uncertainty within the chain. However, maximizing ISCM efficiency in a highly volatile global economic era can no longer rely solely on speed or low costs; rather, it requires the Triple-A Supply Chain framework, which consists of three systematically interconnected dimensions (Lee, 2004): 1) Agility: The ability to respond promptly to short-term fluctuations in demand and supply, such as coping with fuel shortages or sudden shifts in global market prices; 2) Adaptability: The ability to restructure the supply chain to align with long-term economic trends and market structures, such as shifting fuel sourcing origins or strategic transportation routes; and 3) Alignment: The establishment of shared interests, information, and incentives among trading partners.

When synthesizing the ISCM concept and the Triple-A framework within the context of energy and fuel supply chain management, it is evident that coordination does not stop solely at Business-to-Business (B2B) levels; rather, it must expand to macro-level integration between the public sector (policy-makers, regulators, and price control mechanisms) and the private sector (import and distribution operators). The combination of technology, shared information systems, and public-private strategic alignment serves as the core heart for building transparency, reducing excess costs, and maximizing resilience to respond to national energy emergencies and crises.

2.3. Energy & Fuel Security

In the pioneering era, the foundations of modern energy security were frequently defined through primary objectives such as ensuring a reliable and affordable energy supply to maintain economic growth stability, while warning against “supply disruption risks” and highlighting the necessity of diversifying energy sources (Yergin, 1991). Subsequently, academic literature expanded this conceptual scope by demonstrating that energy security is neither merely a microeconomic nor a macroeconomic issue, but rather a “national security dimension” directly related to geopolitical competition for the control of global production sites and strategic transportation checkpoints, such as the Strait of Hormuz (Klare, 2001). Concurrently, an alternative perspective emerged through the concept of Soft Energy Paths, which emphasizes demand-side management, energy efficiency, and the reduction of reliance on imported fuel to build long-term system resilience (Lovins, 2011).

To ensure that the assessment of the energy security dimension is comprehensive and aligned with international standards, modern academic literature incorporates the 4As framework—endorsed by international organizations such as APEC and IEA—into in-depth analysis, comprising (Asia-Pacific Economic Cooperation, 2007): 1) Availability: the capability to procure sufficient energy to meet national demand across both short-term and long-term horizons; 2) Accessibility: the convenience and security of accessing energy sources as well as transit transportation routes without obstruction from geopolitical factors; 3) Affordability: the ability to pay for energy at a reasonable price.

bility: the requirement that energy and fuel price structures remain at a level sustainable for citizens and the business sector without imposing an undue burden on macroeconomic stability; and 4) Acceptability: the imperative that energy governance aligns with standards for pollution mitigation and climate change adaptation. Furthermore, contemporary literature emphasizes the integration of the resilience dimension into the system to evaluate the capability of the supply chain to absorb shocks from global market volatility, disasters, or emergency crises, ensuring swift and robust recovery toward normal operations.

2.4. The Role of the State and Market Mechanisms in the Lao PDR

The transition from a centrally planned economy to a market economy in the Lao PDR was grounded theoretically and practically through the ideology of Kaysone Phomvihane at the 4th National Congress (1986). By accepting market mechanisms, private property, and competition while maintaining the state's macroeconomic management role, this philosophy does not reject capitalism entirely; rather, it utilizes market mechanisms as a tool to expand productive forces through the synergy of multiple economic sectors (public, domestic private, foreign, and joint-ventures). In the dimensions of political science and political economy, the Lao PDR adopted a gradualist transition strategy rather than “shock therapy” as seen in certain Eastern European countries. This aligns with academic analyses indicating that such a strategy enables the state to preserve political stability and its monopoly on leadership while maintaining a firm grip on strategic economic sectors (such as energy, electricity, and mining), alongside opening space for the private sector to drive general commerce (Stuart-Fox, 1986). Consequently, the evolution of the modern state's role has shifted from a direct producer and business operator to a “regulator and facilitator” providing an enabling environment for investment.

Economic governance in the Lao PDR is thus driven under the principle of a “State-Managed and Market-Driven Mechanism” with a systematic division of responsibilities: 1) Market mechanisms function as an allocator of resources and a determinant of prices based on supply and demand to foster economic flexibility; and 2) The state intervenes to correct market failures and preserve macroeconomic stability—for instance, through the regulatory oversight of the Ministry of Industry and Commerce (MoIC) in managing the fuel price stabilization fund, determining pricing structures, and establishing strategic fuel reserve policies to ensure national energy security. Under conditions of economic downturn or severe supply shocks, the free market system inherently faces inherent market instability and lacks an automatic mechanism to consistently adjust toward equilibrium. Furthermore, the problem of information asymmetry impacts the efficiency of resource allocation (Keynes, 1936). Consequently, the state plays a critical role in establishing regulatory frameworks to prevent monopolistic behaviors, protect consumer rights (Stiglitz, 2002), and implement concrete industrial policies to support sectors with low competitive capacity. This corresponds with the politi-

cal-economic reality that no country in the world can achieve prosperity through a completely unfettered free market mechanism without state guidance and strategic planning (Chang, 2002).

3. Analysis and Results

3.1. Challenges in Managing the Fuel Supply Chain in the Lao PDR

As the Lao PDR is a landlocked country lacking domestic crude oil reserves and domestic refining facilities, it relies 100% on imports through neighboring countries, rendering its fuel supply chain highly vulnerable to external factors. Land-based fuel transportation incurs high costs and is tied to Lao Kip exchange rate fluctuations. Combined with the government's rigid price control mechanism, this creates liquidity pressures and asymmetric price transmission. Regarding the regulatory framework—specifically Decree No. 559/PM—it imposes a considerable burden on the private sector through asymmetric burden-sharing, via requirements for a 300 billion kip registered capital and a 70% - 100% reserve stock obligation. Such regulations place fuel suppliers or co-suppliers in a state of capital lock-up. Meanwhile, several fuel co-suppliers report operational irregularities, such as unfair price-cutting and cross-brand selling due to inspection limitations. Although technologies (ATG, POS, GPS) are utilized, continuous real-time data integration between the public sector and private operators remains lacking, meaning that demand forecasting and strategic reserve planning urgently require upgrading as follows:

3.1.1. Procurement

The fuel procurement structure of the Lao PDR is deeply tied to the global fuel market, carrying obligations for settlement in foreign currencies (USD and THB). These conditions generate macroeconomic risks that directly impact import operators, such as foreign currency shortages combined with the severe fluctuations in exchange rates between the Lao Kip and foreign currencies mentioned above. These issues lead to higher procurement costs and create severe liquidity pressure for fuel importers and distributors. However, the mechanism for setting and announcing retail price structures under state regulation remains delayed (lagged response) and inconsistent with actual price fluctuations in the global market. Such inconsistency creates financial pressure, causing operators to experience negative returns (losses) or compelling them to temporarily suspend energy imports, thereby affecting the continuity and security of the domestic fuel supply chain (supply continuity). To ensure volume security, import operators and domestic suppliers are required to establish long-term term contracts with refineries in Thailand, Vietnam, China, and upstream source countries. Nevertheless, this business structure requires operators to possess foreign exchange risk management capabilities due to the asymmetry between the currencies used for procurement (USD/THB) and those used for distribution (LAK), alongside the utilization of price hedging tools in the global market to mitigate the impacts of energy price

volatility.

3.1.2. Import Process

The import process and fuel transportation system of the Lao PDR are under strict management and regulatory control by the public sector through the Decree on Fuel Business. The majority of import networks are expanded through major international border checkpoints, including: the First Lao-Thai Friendship Bridge Checkpoint (Vientiane-Nong Khai), the Third Lao-Thai Friendship Bridge Checkpoint (Khammuane-Nakhon Phanom), the Fourth Lao-Thai Friendship Bridge Checkpoint (Bokeo-Chiang Rai), and the Vangtao-Chong Mek International Checkpoint (Champasak-Ubon Ratchathani). Specifically, the First Lao-Thai Friendship Bridge Checkpoint serves as the main arterial route for transporting such energy to Vientiane Capital and the central provinces. Regarding import licensing, import rights are strictly limited to enterprises officially authorized and legally registered with the MoIC. According to the latest official data, there are 11 companies authorized to import and export fuel: (Somvanvilay Petroleum Jewelry Co., Ltd.; Lo Petroleum Sole Co., Ltd.; PetroVietnam Oil Laos Co., Ltd.; Petrotrade Import-Export Co., Ltd.; Lao State Fuel Enterprise; NTP Fuel Trading Public Company; TT Power Total Sole Co., Ltd.; Dalachaleun Fuel Import-Export Sole Co., Ltd.; Asia Fuel Import-Export Co., Ltd.; Petrolimex Laos Sole Co., Ltd.; and Vientiane Fuel State Enterprise). There are 14 companies authorized to distribute fuel domestically: (Lao State Fuel Enterprise; Petrotrade PUMA Energy Distribution Co., Ltd.; TT Power 45 Co., Ltd.; Dalachaleun Star Oil Laos Sole Co., Ltd.; DNM Distributor Sole Co., Ltd.; PetroVietnam Oil Domestic Distribution Sole Co., Ltd.; NTF Domestic Distribution Co.; Petrolimex Laos Domestic Distribution Sole Co., Ltd.; Asia Fuel Distribution Co.; Somvanvilay Petroleum Jewelry Domestic Distribution Sole Co., Ltd.; Buasavan Energy Sole Co., Ltd.; FTT Laos Co., Ltd.; Petrolao Trading Co., Ltd.; and Phokeo Petroleum Trading Co., Ltd.) (Online) <https://www.laotradeportal.gov.la/lo-la/site/display/2078>.

However, this energy import process requires authorized operators to submit annual distribution plans to the MoIC. Simultaneously, importers must possess a Certificate of Quality from the source or upstream suppliers. The main imported fuel product types include premium gasoline, regular gasoline, and diesel, all of which must fully pass technical standard inspections. Total fuel import statistics for the Lao PDR in 2025 reached 2,031,726,452 liters. Among these, the primary import source was Thailand (97.30%), followed by Vietnam (2.64%) and China (0.06%). Diesel fuel had the highest demand, with imports reaching 1,666,152,214 liters in 2025, followed by Gas-91 gasoline at 328,400,320 liters. Fuel imports in the first half of 2026 (January-June 2026) totaled 990,703,141 liters, categorized as: regular gasoline (158,401,892 liters), premium gasoline (12,383,019 liters), and diesel (819,918,230 liters) (Domestic Trade Department, 2026). All import activities must strictly pass through officially designated international border checkpoints to ensure effective control and monitoring.

3.1.3. Cross-Border Transportation

The transportation and movement of fuel within the Lao PDR fundamentally rely on road transport using tanker trucks owned by the importing companies themselves, sourced from upstream storage depots in neighboring countries. Every import process is mandated to pass exclusively through government-approved international border stations. To ensure transparency and minimize traditional paperwork, upon arrival at the Lao border checkpoint, transport vehicles must complete customs declarations via the Lao National Single Window (LNSW) system. In terms of domestic transport services, the Lao State Fuel Enterprise (LSFE) and private operators maintain their own transport fleets to provide movement and distribution services to customers nationwide, covering both plateau and mountainous regions, while also possessing efficient cross-border transit service capabilities. Currently, fuel import and distribution companies operate over 140 heavy-duty fuel tanker trucks. However, during the rainy season, certain routes are frequently affected by natural disasters such as floods and landslides, causing delays in delivery or fuel supply, particularly in remote rural areas, especially in the northern parts of the country. For example, fuel transport trucks traveling from depots in Vientiane Capital to Houaphanh Province take 2 - 3 days to arrive, occasionally encountering landslides and insufficient storage capacities at the destination. Such conditions reflect three major logistical obstacles: 1) long cross-border transport distances combined with heavy reliance on tanker trucks; 2) limitations in transportation infrastructure standards, seasonal road damages, and accident risks, which lead to supply delays; and 3) technical inspection procedures, customs procedures, and border checkpoint management that remain delayed during certain periods, acting as variables that increase cross-border fuel import times and automatically generate business burdens (**Figure 1**).



Figure 1. Fuel tankers wait at the Chong Mek (Thailand)- Vangtao (Laos) border checkpoint.

3.1.4. Inspection and Storage

The management of imported fuel quality is subject to strict technical inspections at border checkpoints and storage depots to ensure compliance with national standards (NS) officially prescribed and certified by the MoIC (e.g., diesel fuel standards under Decision No. 0534/MoIC), with the objective of protecting consumers and controlling the quality of imported goods. Following verification, products are transported and stored in petroleum depots lawfully authorized by the importing companies (Lao Government, 2025). For example, storage depots of the LSFE await distribution, where any import bypassing storage facilities in accordance with regulatory frameworks is deemed illegal.

In terms of structural standards and product categories, High Speed Diesel is utilized for transport vehicles and heavy machinery, with major distribution operators (such as PTT Laos) having upgraded their fuel distribution to a base-line EURO 4 standard. Quality management is also linked to import sources from Thailand, which has enforced the EURO 5 standard (limiting sulfur content to no more than 10 ppm), resulting in a de facto upgrade of a portion of imported fuel quality to support modern engine technologies and reduce air pollution (PM 2.5). Imported gasoline/petrol is categorized into two main types based on octane number: 1) Premium Gasoline (Premium ULG 95), with an octane rating of no less than 95, designed for new automobiles, sports cars, or high-compression engines; and 2) Regular Gasoline (Regular ULR 91), with an octane rating of no less than 91, suitable for motorcycles and general vehicles. Regarding market quality control mechanisms, the National Testing and Quality Inspection Center, in collaboration with trade inspection officials, conducts random sampling at service stations nationwide, enforcing strict legal measures and penalties for cases where products sold fall below national standards.

In the dimension of emergency preparedness, the risk management architecture and infrastructure readiness of the Lao PDR still face several limitations, such as a restricted macro-level strategic fuel reserve storage capacity relative to actual nationwide consumption rates, which undermines the capacity to buffer or withstand fuel scarcity crises. Certain storage depots are urgently required to be upgraded in terms of management automation, fire suppression systems, and compliance with international environmental standards to mitigate the risks of major accidents and ecological impacts. Currently, the country possesses a total of 222 fuel storage depots with a combined storage capacity of 236,455,000 liters (categorized as 102 depots in the central region with a total volume of 109,192,000 liters; 78 depots in the northern region with a total volume of 88,130,000 liters; and 42 depots in the southern region with a total volume of 39,133,000 liters). However, when compared with the continuously growing energy demand, the necessity to expand storage capacity and upgrade strategic reserves remains a priority condition for ensuring national energy security (Department of Standards and Metrology, 2025) (Figure 2).



Figure 2. Scenes of people queuing hours-long for fuel in Vientiane in Mar 2026.

3.1.5. Domestic Distribution

The distribution of fuel from strategic storage depots to service stations (fuel stations) nationwide is carried out through the domestic transport fleet. Retail price structures at distribution stations are officially determined and regulated by the Department of Internal Trade, MoIC, to align with global energy market price fluctuations and exchange rate volatility. Currently, there is a total of 2,257 fuel service stations or dispensing stations nationwide, with a combined total storage capacity of 85,655,526 liters (categorized as: 1096 stations in the central region with a capacity of 39,978,025 liters; 798 stations in the northern region with a capacity of 33,449,500 liters; and 363 stations in the southern region with a capacity of 12,228,001 liters) (Domestic Trade Department, 2026). However, fuel suppliers report that the adjustment of retail price structures at distribution stations remains delayed relative to these fluctuating conditions. The domestic fuel distribution supply chain faces two major dimensional challenges: 1) high transportation costs due to geographical conditions in accessing remote rural and mountainous areas. This situation directly causes service stations in such areas to frequently experience supply shortages, alongside actual retail prices higher than those in major urban areas, acting as a barrier to equity in people's access to basic commodities; and 2) limitations in public sector resources and readiness result in insufficient comprehensive coverage in inspecting and controlling quantity standards as well as product quality across retail stations nationwide, increasing risks to the effectiveness of protecting consumer rights and interests at the grassroots level. During the 2026-2030 period, total fuel demand is projected to increase by 5% per year, as shown in **Table 1** below:

Table 1. Projected fuel demand for the Lao PDR (2026-2030).

Year	Grand total (increasing by 5% per year)	Central region 60%	Northern region 20%	Southern region 20%
2026	2.097.522.561	1.258.513.537	419.504.512	419.504.512
2027	2.202.398.689	1.321.439.213	440.479.738	440.479.738
2028	2.312.518.623	1.387.511.174	462.503.725	462.503.724
2029	2.428.144.555	1.456.886.733	485.628.911	485.628.911
2030	2.549.551.782	1.529.731.069	509.910.357	509.910.356

Source: Department of Domestic Trade, MoIC, Lao PDR.

3.2. Appropriate Approaches for Managing a Secure and Sustainable Fuel Supply Chain in the Lao PDR

The results derived from the analysis of situational problems and structural challenges within the fuel supply chain in the Lao PDR indicate an urgent imperative to strengthen and enhance the efficiency of management mechanisms throughout the entire end-to-end supply chain. To ensure energy security and long-term sustainability amidst macroeconomic volatility both domestically and internationally, this report synthesizes and proposes key strategic guidelines as follows:

3.2.1. Procurement and Strategic Cost Management

Enhancing procurement capacity and mitigating energy supply risks requires a comprehensive strategic framework. The process begins with strategic sourcing toward regional strategic markets, particularly Thailand, Vietnam, and China, alongside the development of alternative logistics routes to reduce vulnerability stemming from an over-reliance on any single transportation corridor and to increase readiness for emergency preparedness. In terms of business operations, importing enterprises are required to commit to long-term contracts with suppliers, refineries, or major energy trading companies within partner countries (Thailand, Vietnam, Singapore, and others) to ensure volume security. Concurrently, operators must possess the capability for foreign exchange risk management due to the asymmetry between currencies utilized for upstream settlement (USD, THB) and downstream distribution (LAK), including the deployment of price hedging and currency matching instruments in global markets to absorb energy price volatility. Furthermore, diversifying the partner network reinforces bargaining power regarding costs and premiums.

Regarding the role of the public sector, intervention measures and macroeconomic support mechanisms are decisive factors in procurement processes and strategic cost management. Crucially, the public sector should coordinate with the Bank of the Lao PDR (BOL) to systematically establish a prioritized foreign currency (USD/THB) quota allocation mechanism that is sufficient for strategic importing enterprises, while promoting transactions through local currency settlement (LAK/THB or LAK/CNY) with trading partners to alleviate pressure and demand for the US dollar. The public sector must enhance the resilience of retail

price calculation and announcement formulas to ensure they are cost-reflective and adjust to global market fluctuations with timely adjustment, which will protect the financial liquidity of operators and prevent accumulated losses that could force operators to temporarily suspend imports.

3.2.2. Import Processes

Upgrading efficiency and transparency in the fuel import process serves as a core strategic dimension in reducing logistics costs and ensuring the continuity of the national energy supply across three strategic dimensions: 1) diversifying and harmonizing multimodal transport networks. This means that beyond relying primarily on road transport, the public sector and operators must promote integration through rail systems (such as the Lao-China Railway) and pipeline systems from Vietnam. They should also leverage new alternative routes, such as connecting via the strategic Vung Ang Port (in Vietnam)—in which the Lao PDR is a co-investor—to reduce unit costs, increase agility, and build resilience for the fuel supply chain; 2) enhancing trade facilitation and streamlining border procedures to eliminate delays by upgrading inspections to a single window system and electronic customs (e-Customs). Concurrently, a 100% paperless integration should be adopted for submitting demand plans and applying for import licenses from the MoIC in accordance with approved quotas; and 3) integrating macro-level data by establishing a real-time information-sharing mechanism among the MoIC, the Ministry of Finance (Department of Customs), and the BOL. Such integration will ensure that foreign currency approvals and allocations are consistent and synchronized with actual import demand volumes. Furthermore, this requires the rigorous enforcement of safety standard frameworks through systemic technical vehicle inspections and driver fitness-for-duty assessments to mitigate accident risks and ensure uninterrupted business continuity.

3.2.3. Cross-Border Transportation

The physical movement of petroleum products from upstream sources across the border into the Lao PDR fundamentally relies on a primary transportation network via road transport using tanker trucks through international border checkpoints. However, the analysis reveals that imports via rail systems (the Lao-China and Lao-Thai railways) have begun to be expanded and integrated into parts of the supply chain. Promoting and increasing the proportion of transport via rail transport represents a high-priority strategic importance due to its bulk capacity per trip, higher safety standards, and ability to effectively reduce unit logistics costs compared to relying solely on road-based tanker trucks. In the dimension of border checkpoint management, to resolve delays and enhance trade facilitation, the study calls for upgrading and developing the LNSW system to achieve higher efficiency—specifically establishing mechanisms for technical and regulatory document inspections as well as priority clearance for fuel transport vehicles. This will help cut down border dwell times and ensure the continuity of macro-level energy supplies.

3.2.4. Inspection and Storage

Warehouse/depot management and quality control (QC) systems serve as critical connection points after fuel products undergo border checkpoint inspections and are unloaded into main storage depots. Operational measures dictate strict random sampling for laboratory analysis regarding octane numbers, color indexes, and the absence of impurities. Such storage depot structures function as a “buffer stock” (strategic reserve) to guarantee national energy stability and security. In the dimension of upgrading macro-level crisis resilience, the public and private sectors must collaborate under PPPs framework to expand the storage capacity of the NSPR. The strategic objective is to upgrade reserve volumes to sustain domestic consumption for at least 30 - 45 days (compared to the current capacity, which remains limited to short durations), serving as a risk-mitigation measure and a response to fuel scarcity crises that may arise from external factors or conflicts in fuel-producing countries.

To enhance management and risk management efficiency, current operational systems must be transformed into smart automation through various dimensions: 1) utilizing Automatic Tank Gauging (ATG) systems to reduce loss rates from evaporation or leakage; 2) developing a centralized IT platform to integrate data among the public sector, upstream operators, and reserve depots, enabling real-time stock level monitoring; 3) establishing a PPD mechanism with fuel associations to assess market conditions and respond to crises proactively; and 4) integrating data from GPS tracking, ATG, and Point of Sale (POS) into a central database before combining it with big data analytics to accurately forecast seasonal demand patterns. These elements will serve as a vital foundation for strategic import planning and the sustainable, highly efficient management of national inventories.

3.2.5. Domestic Distribution and Transportation

The downstream distribution process of the supply chain serves as a crucial mechanism for delivering products to final consumers. Delivering fuel from main storage depots to retail service stations and commercial/industrial sectors generally relies on medium and small transport fleets. To upgrade operational efficiency, operators utilize Global Positioning System (GPS) tracking technology integrated with route planning software to calculate and allocate delivery routes with maximum energy efficiency while reducing empty running rates. Furthermore, modern digital systems integrate retail stock levels to transmit directly to the main depot in real-time, enabling depots to plan and deliver replacement fuel promptly before stock depletion occurs, without the necessity of traditional phone orders.

Ensuring the stability and security of the fuel supply chain requires comprehensive strategic management measures to establish a balance among equity, consumer protection, and infrastructure strengthening. The core focus is developing transportation subsidy policies for remote rural areas to prevent supply shortages and reduce price disparity. Concurrently, the public sector should enhance the

rigor of inspecting product quality standards and measuring equipment accuracy across retail stations to genuinely protect consumer rights and interests. Moreover, macro-level risk management dimensions require enforcing minimum stock-piling requirement legal frameworks at 30 - 45 days, while promoting PPP investment models for constructing large-scale storage depots and pipeline systems. Distributing reserve depot bases to cover strategic zones nationwide will be a key variable in reducing logistics costs and ensuring the sustainable continuity of fuel distribution. Importantly, the public sector should promote renewable energy and alternative energy, such as electric vehicles (EVs), while simultaneously expanding EV charging stations to cover major national routes.

4. Conclusion and Discussion

This study reflects a highly vulnerable macroeconomic structure stemming from being a landlocked country with 100% dependence on fuel imports. Through the synthesis of the ISCM, Triple-A, and 4As frameworks, three strategic issues were identified: 1) market failure and the necessity of state intervention arising from exchange rate fluctuations (USD/THB) and liquidity constraints, combined with the lagged response of price control mechanisms, creating the risk of accumulated losses and temporary import suspensions for operators; and 2) the findings align with the perspectives of [Stiglitz \(2002\)](#), [Chang \(2002\)](#) and [Keynes \(1936\)](#), which posit that free markets cannot self-correct toward equilibrium during crises, thereby necessitating an active state role in intervention and the establishment of flexible stabilization mechanisms. These issues necessitate an upgrade toward a Smart Supply Chain to mitigate risks from road transportation and storage depot limitations, requiring the adoption of multimodal transport diversification—such as rail routes (Lao-China/Lao-Thai)—alongside smart automation (ATG, GPS, ERP, and LNSW). Such measures will effectively enhance agility and adaptability against shock conditions. Ensuring energy security requires integrated coordination by balancing transportation subsidies for remote areas, consumer protection, and the enforcement of petroleum reserve legal frameworks through PPP models. These elements will serve as the foundational drivers for strategies under the principle of “State Governance - Market Expansion” toward sustainable development.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- Asia-Pacific Economic Cooperation (2007). *A Quest for Energy Security in the 21st Century*. APEC Secretariat.
- Burrows, M. C., & Gattorna, J. L. (2008). *Dynamic Supply Chain and Resilience*. Palgrave Macmillan.
- Chang, H. J. (2002). *Kicking away the Ladder: Development Strategy in Historical Perspective*. Anthem Press.

- Department of Standards and Metrology (2025). *Control of Quality, Quantity, and Accuracy Regarding the Import and Distribution of Fuel in the Laos, Vientiane*.
<https://www.laotradeportal.gov.la/en-gb/search-measure/view/387>
- Domestic Trade Department (2026). *Letter of Response to the Department of Market Management and Development. No. 1559/DMDD*. Ministry of Industry and Trade of Vietnam.
- Forrester, J. W. (1961). *Industrial Dynamics*. MIT Press.
<https://www.laotradeportal.gov.la/en-gb/site/display/2078>
- Keynes, J. M. (1936). *The General Theory of Employment, Interest, and Money*. Macmillan.
- Klare, M. T. (2001). *Resource Wars: The New Landscape of Global Conflict*. Metropolitan Books.
- Lambert, D. M. (2014). *Supply Chain Management: Processes, Partnerships, Performance* (4th ed.). Supply Chain Management Institute.
- Lambert, D. M., & Cooper, M. C. (2000). Issues in Supply Chain Management. *Industrial Marketing Management*, 29, 65-83. [https://doi.org/10.1016/s0019-8501\(99\)00113-3](https://doi.org/10.1016/s0019-8501(99)00113-3)
- Lao Government (2025). *Decree on Fuel Business No. 559/PM*.
- Lee, H. L. (2004). The Triple—A Supply Chain. *Harvard Business Review*, 82, 102-112.
- Lovins, A. B. (2011). *Soft Energy Paths: Toward a Durable Peace*. Harper & Row.
- Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining Supply Chain Management. *Journal of Business Logistics*, 22, 1-25.
<https://doi.org/10.1002/j.2158-1592.2001.tb00001.x>
- Oliver, R. K., & Webber, M. D. (1982). Supply-Chain Management: Logistics Catches up with Strategy. *Outlook*, 5, 42-47.
<https://www.semanticscholar.org/paper/Supply-chain-management%3A-logistics-catches-up-with-Oliver-Webber/a9b24f14f723613361e6568f9885f53ce056675b>
- Porter, M. E. (1985). Value Chain, Upstream to Downstream Activities. In *Competitive Advantage: Creating and Sustaining Superior Performance* (pp. 33-61). Free Press.
- Stiglitz, J. E. (2002). *Globalization and Its Discontents*. W. W. Norton & Company.
- Stuart-Fox, M. (1986). *Laos: Politics, Economics and Society*. Frances Pinter.
- Xaysongkham, V (2026). Strengthening and Ensuring the Sustainability of State-Owned Enterprises in the Lao PDR: Approaches to Reform and Good Corporate Governance. *Journal of Social Sciences*, 26, 9-17.
- Yergin, D. (1991). *The Prize: The Epic Quest for Oil, Money, and Power*. Simon & Schuster.