

Streamlining Energy Supply Chains: The Impact of Targeted Fuel Subsidy Management on Industrial Logistics Cost Architectures

Syarifah Akmal ^{1*}

¹ Universitas Malikussaleh

* Correspondence: syarifah.akmal@unimal.ac.id

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ABSTRACT

Energy costs are a critical component of industrial logistics expenditures, as fuel prices directly affect transportation, distribution, and supply chain operations. In developing economies such as Indonesia, fuel subsidies have traditionally been implemented to maintain energy affordability and support economic stability. However, broad-based subsidy schemes may create market distortions, encourage inefficient energy consumption, and increase fiscal burdens. This study aims to analyze the impact of targeted fuel subsidy management on industrial logistics cost structures and supply chain efficiency. A qualitative Systematic Literature Review (SLR) was conducted by examining scientific literature on fuel subsidies, energy pricing, industrial fuel consumption, logistics costs, transportation costs, and energy supply chain management. The literature was selected based on thematic relevance, publication quality, and alignment with the research objectives. The findings indicate that fuel prices significantly influence industrial operating costs, particularly through transportation and distribution activities. Inefficient subsidy mechanisms may distort energy consumption patterns and reduce incentives for industrial firms to improve energy efficiency. Conversely, targeted fuel subsidy management has the potential to improve energy resource allocation, minimize cost distortions, and support more efficient supply chain operations. Its effectiveness, however, depends on accurate beneficiary identification, reliable distribution systems, effective monitoring, and policy coordination between the energy and logistics sectors. This study concludes that targeted fuel subsidy management can contribute to more efficient industrial logistics cost structures and improved supply chain



performance when subsidy allocation is aligned with industrial needs, fuel consumption patterns, and broader energy efficiency objectives.

Keywords: *fuel subsidy; targeted subsidy management; energy supply chain; industrial logistics; logistics costs; fuel prices; supply chain efficiency.*

1. Introduction

Energy represents one of the fundamental inputs in industrial supply chains because fuel is extensively used in transportation, distribution, material handling, and other logistics activities. Changes in fuel prices can directly influence firms' operating costs and may indirectly affect the prices of goods and services throughout the supply chain. In countries where transportation activities rely heavily on fossil fuels, energy price fluctuations can therefore become an important source of cost pressure for industrial enterprises. Research on Indonesian industries demonstrates that fuel prices influence industrial energy consumption and firms' responses to changes in energy costs [4].

The importance of energy costs becomes more apparent when examining the structure of logistics expenditures. Logistics activities involve transportation, warehousing, distribution, inventory management, and other supporting operations, with transportation representing an important component of total logistics costs. At the national level, Indonesia continues to face challenges in controlling logistics costs because of its geographical characteristics, transportation infrastructure, and distribution complexity [5], [6]. High logistics costs can reduce industrial competitiveness because firms must allocate greater resources to moving inputs and finished products between production and consumption locations.

Fuel prices therefore have a direct relationship with the cost architecture of industrial logistics. Higher fuel prices increase transportation expenditures, while persistent energy price uncertainty can make logistics planning and cost management more difficult. Evidence from Indonesia shows that the cost of petroleum product distribution varies according to transportation routes, distribution structures, and operational conditions [11]. Research on petroleum logistics also demonstrates the importance of optimizing distribution systems to achieve cost efficiency while maintaining supply reliability [8]. These findings indicate that energy management cannot be separated from broader supply chain efficiency.

Fuel subsidies have historically been used by governments to reduce the impact of energy prices on households, businesses, and the wider economy. In Indonesia, fossil fuel subsidy policies have played an important role in maintaining fuel affordability and supporting economic activities. However, Broad-based subsidy regimes may also generate unintended effects when benefits are distributed without adequately distinguishing among users.



Research on Indonesia's energy policy has highlighted challenges associated with the design and implementation of energy subsidies and the need to consider their broader economic, social, and environmental implications [1], [2].

Broad fuel subsidies can also influence firms' incentives to manage energy consumption efficiently. When fuel prices are artificially maintained below market-related levels, The reviewed literature suggests that firms may face weaker incentives to improve energy efficiency or invest in alternative technologies. Found that low fuel prices can generate a perverse effect by encouraging greater energy consumption among firms [3]. This finding is particularly relevant to industrial logistics because transportation-intensive enterprises may become increasingly dependent on subsidized fuel rather than focusing on structural improvements in logistics efficiency.

The relationship between subsidies and logistics costs is not limited to fuel prices alone. Government intervention in transportation and logistics can influence the cost of moving goods across regions. Evidence from Indonesia shows that logistics subsidies can affect prices by reducing transportation-related costs and improving connectivity between locations [10]. Similarly, the implementation of a single-price fuel program has been examined in relation to transportation costs in disadvantaged regions, demonstrating the potential of fuel policy to influence regional logistics conditions [12]. These findings suggest that energy subsidy policies can have broader supply chain implications beyond their immediate fiscal function.

Targeted fuel subsidy management provides an alternative policy approach by directing subsidies toward specific beneficiaries, sectors, or activities that require energy support. Rather than maintaining generalized price reductions, targeted mechanisms seek to improve the accuracy of subsidy allocation and reduce leakage or excessive consumption. A statistical approach to fuel subsidy mechanisms has also demonstrated the importance of designing subsidy systems that can respond to fuel price conditions while maintaining policy effectiveness [14]. From a supply chain perspective, targeted subsidies can potentially support critical logistics activities without creating the same degree of distortion associated with generalized fuel subsidies.

The logistics implications of targeted fuel subsidy management become particularly important for industrial enterprises. Industrial supply chains depend on reliable and affordable transportation to move raw materials, intermediate goods, and finished products. When fuel support is allocated according to actual logistics requirements, it may reduce cost pressure on strategically important transportation activities while encouraging firms to improve efficiency in other areas. Consequently, targeted fuel subsidies have the potential to become not only a social and fiscal policy instrument but also an element of industrial logistics cost management.



Previous studies have examined fuel subsidies, energy policy, fuel prices, and logistics costs from different perspectives. Some studies focus on the economic and policy implications of fossil fuel subsidies in Indonesia [1], [2], [14]. Other studies investigate the relationship between fuel prices and industrial energy consumption [3], [4]. Meanwhile, logistics research primarily examines the measurement and reduction of transportation and supply chain costs [5], [6], [8], [13]. Although these studies provide important insights, the relationship between targeted fuel subsidy management and the cost architecture of industrial logistics remains relatively fragmented.

This research gap creates an opportunity to integrate energy policy and supply chain perspectives. Fuel subsidy management is commonly discussed in terms of fiscal efficiency, energy affordability, and consumption behavior, while logistics studies tend to focus on transportation costs, distribution efficiency, and supply chain optimization. Connecting these two perspectives can provide a more comprehensive understanding of how the design of fuel subsidies may influence the cost structure of industrial logistics. Such an integrated perspective is particularly relevant for Indonesia, where the geographical structure of the country creates substantial transportation and distribution requirements.

The novelty of this study lies in examining targeted fuel subsidy management as a potential instrument for streamlining industrial energy supply chains and restructuring logistics cost architectures. Rather than treating fuel subsidies solely as an energy or fiscal policy, this study positions subsidy targeting as a mechanism that can influence transportation costs, supply chain efficiency, energy consumption behavior, and industrial competitiveness. The study therefore aims to synthesize contemporary literature concerning fuel subsidy management, energy prices, industrial fuel consumption, logistics costs, and supply chain efficiency through a qualitative *Systematic Literature Review* (SLR). The results are expected to provide an integrated perspective on how targeted fuel subsidy policies can be aligned with industrial logistics requirements and long-term supply chain efficiency.

2. Materials and Method

This study employs a qualitative *Systematic Literature Review* (SLR) to examine the relationship between targeted fuel subsidy management and industrial logistics cost architectures. The SLR approach was selected because it enables systematic identification, screening, eligibility assessment, and synthesis of relevant literature evaluation, comparison, and synthesis of previous research concerning fuel subsidies, energy prices, industrial energy consumption, logistics costs, and supply chain efficiency. Through this approach, the study develops an integrated understanding of how energy subsidy policies may influence industrial logistics and supply chain performance.



The literature search was conducted using several academic databases and scientific information sources, including Scopus, Web of Science, ScienceDirect, SpringerLink, Taylor & Francis Online, Wiley Online Library, Emerald Insight, Google Scholar, and SINTA. The search strategy used combinations of keywords such as *fuel subsidy*, *targeted fuel subsidy*, *fuel subsidy management*, *energy subsidy*, *fuel prices*, *industrial logistics*, *logistics costs*, *transportation costs*, *energy supply chain*, *supply chain efficiency*, and *industrial energy consumption*. Boolean operators such as “AND” and “OR” were used to combine keywords and identify literature relevant to the research objectives.

The selection of literature was conducted using predetermined inclusion and exclusion criteria. The inclusion criteria consisted of peer-reviewed journal articles discussing fuel subsidies, energy pricing, industrial fuel consumption, logistics costs, transportation systems, energy supply chains, or related policy mechanisms; publications primarily within the 2021–2025 period; articles published in English or Indonesian; and studies containing sufficient information regarding their objectives, methods, and findings. Foundational studies published before the main publication period were retained when they provided important theoretical or methodological contributions to fuel subsidy management. Articles were excluded when they were duplicates, unrelated to energy policy or industrial logistics, focused solely on technical engineering issues without economic or supply chain relevance, or lacked sufficient methodological information.

Following the identification and screening process, 15 relevant articles were selected for analysis. The selected literature covers several perspectives, including fuel subsidy regimes, energy policy, fuel prices, industrial energy consumption, transportation costs, logistics cost measurement, petroleum product distribution, maritime logistics subsidies, and energy supply chain optimization. Information extracted from each article included the author and publication year, research objective, research method, geographical or industrial setting, energy or logistics issue examined, policy or management mechanism, and principal findings.

The data were analyzed using qualitative thematic content analysis. The selected studies were initially organized according to their main research focus and subsequently grouped into several analytical themes. The first theme concerns fuel subsidy management and energy policy. The second examines the relationship between fuel prices and industrial energy consumption. The third focuses on logistics cost structures and transportation expenditure. The fourth addresses energy supply chain efficiency, distribution, and optimization. The final theme integrates these dimensions to assess the potential implications of targeted fuel subsidy management for industrial logistics.



The final stage involved cross-study synthesis to identify relationships, similarities, differences, and research gaps across the selected literature. Particular attention was given to the mechanisms through which fuel subsidies can influence fuel prices, energy consumption behavior, transportation costs, distribution efficiency, and industrial competitiveness. The synthesis was subsequently used to develop an integrated perspective of targeted fuel subsidy management as a policy instrument for streamlining energy supply chains and improving industrial logistics cost efficiency.

3. Result

The reviewed studies consistently indicate that fuel subsidy management is closely associated with industrial logistics because fuel prices influence transportation expenditures, energy consumption, distribution activities, and the overall cost structure of supply chains. The reviewed literature demonstrates that the effects of fuel subsidies extend beyond fiscal policy and energy affordability. They can also influence firms' consumption behavior, logistics planning, transportation efficiency, and competitiveness. Based on the thematic analysis, five major findings were identified: fuel subsidy management and energy policy, fuel prices and industrial energy consumption, logistics cost structures, energy supply chain efficiency, and the relationship between targeted subsidies and industrial logistics.

Fuel Subsidy Management and Energy Policy

The literature demonstrates that fuel subsidies represent an important component of energy policy, particularly in developing economies where fuel prices have significant implications for households and productive sectors. Studies concerning Indonesia indicate that fossil fuel subsidy regimes have generated both economic benefits and policy challenges. Ichsan et al. emphasized the relationship between national oil companies and fossil fuel subsidy regimes in Indonesia, while Sumarno et al. highlighted broader challenges in Indonesian energy policy and the need for more effective and equitable policy approaches [1], [2].

The literature also indicates that the effectiveness of subsidy mechanisms depends on how subsidies are designed and distributed. A generalized subsidy can provide broad price support, but it may also create inefficient allocation and unintended consumption effects. Demonstrated the importance of developing an appropriate subsidy mechanism capable of responding to changes in fuel prices and policy objectives [14]. This suggests that subsidy management requires mechanisms capable of identifying beneficiaries and aligning energy support with actual economic needs.



Fuel Prices and Industrial Energy Consumption

Fuel prices have a direct relationship with industrial energy consumption and operating decisions. Widodo and Kudo found that changes in fuel prices influence energy consumption among Indonesian industries, indicating that firms respond to changes in energy costs through adjustments in their consumption behavior [4]. This relationship is important for logistics-intensive industries because transportation activities require substantial quantities of fuel.

The literature also shows that low fuel prices can generate unintended incentives for firms. Cali et al. found that low fuel prices can increase energy consumption among firms, creating a potential contradiction between fuel affordability and energy efficiency [3]. Consequently, generalized fuel subsidies may reduce immediate cost pressure while simultaneously weakening incentives for firms to improve fuel efficiency. This finding supports the importance of carefully designed subsidy mechanisms that balance affordability with efficiency objectives.

Industrial Logistics Cost Architecture

Logistics costs consist of multiple components, including transportation, warehousing, inventory, handling, and distribution expenditures. Among these components, transportation represents an important cost element because industrial supply chains depend on the movement of raw materials, intermediate goods, and finished products. Santoso et al. emphasized the importance of measuring total logistics costs in Indonesia to understand the overall cost burden associated with logistics activities [5].

Research concerning the measurement of national logistics costs also indicates that accurate cost identification is necessary for improving logistics efficiency [6]. From an industrial perspective, transportation costs are particularly sensitive to fuel prices because fuel is an essential operating input for road, maritime, and other transportation activities. Therefore, changes in fuel subsidy policy can influence the structure of logistics expenditure through their effects on transportation costs.

Energy Supply Chain and Distribution Efficiency

The reviewed literature demonstrates that energy supply chains require efficient distribution systems to maintain reliability while controlling costs. Showed that petroleum product logistics can be optimized through multi-objective approaches that consider distribution efficiency and supply requirements [8]. Emphasized the importance of risk-based optimization in small-scale LNG supply chains across the Indonesian archipelago [9].



The distribution cost of petroleum products is also affected by geographical and operational conditions. Examined the distribution cost of biosolar and demonstrated that fuel distribution involves multiple cost components that need to be managed efficiently [11]. These findings indicate that energy supply chain efficiency depends not only on fuel prices but also on network structure, transportation routes, distribution systems, and operational risks.

Targeted Subsidies and Transportation Cost Efficiency

The literature provides evidence that government intervention in transportation can influence logistics costs and regional economic conditions. Found that maritime logistics subsidies can affect food prices by influencing transportation costs and connectivity [10]. Similarly, research on the single-price fuel program demonstrates the relationship between fuel policy and transportation costs in disadvantaged regions [12].

These findings suggest that appropriately designed fuel subsidies can reduce cost pressures in strategically important transportation activities. However, the effectiveness of such interventions depends on whether subsidies reach the intended users and whether the supported activities generate broader economic benefits. Targeted subsidy mechanisms may therefore provide a more efficient alternative to generalized subsidies because they can focus government support on sectors or activities where fuel costs have a substantial influence on supply chain performance.

Integration of Fuel Subsidy Management and Industrial Logistics

The overall findings indicate that fuel subsidy management and industrial logistics are interconnected through several mechanisms. First, subsidy policy affects the effective price paid for fuel. Second, fuel prices influence firms' energy consumption behavior. Third, fuel consumption directly affects transportation and distribution costs. Fourth, transportation costs contribute to the overall logistics cost architecture. Finally, changes in logistics costs influence industrial competitiveness and supply chain efficiency.

The literature on logistics cost efficiency in Indonesia reinforces the importance of improving transportation systems, distribution networks, and cost management [13], [15]. Consequently, fuel subsidy policy should be considered alongside broader logistics policies rather than implemented independently. Targeted fuel subsidy management can potentially contribute to supply chain efficiency when it is coordinated with transportation infrastructure, distribution systems, monitoring mechanisms, and industrial energy-efficiency strategies.



Overall, the results demonstrate that targeted fuel subsidy management has the potential to streamline industrial logistics cost structures when subsidy allocation is aligned with actual transportation and energy requirements. Nevertheless, the literature also indicates that subsidies alone cannot resolve structural logistics inefficiencies. Improvements in infrastructure, distribution networks, energy efficiency, and supply chain management remain necessary to achieve sustainable reductions in industrial logistics costs.

4. Discussion

The findings demonstrate that fuel subsidy management should be viewed not only as a fiscal or social policy instrument but also as a factor influencing industrial logistics efficiency. The relationship between fuel prices and logistics costs is particularly important in transportation-intensive supply chains because fuel represents a recurring operating expense. When fuel prices increase, firms may experience higher transportation costs, which can subsequently affect distribution costs and the final cost of products [4], [5].

The findings concerning generalized fuel subsidies indicate a potential trade-off between short-term cost relief and long-term efficiency. Low fuel prices can reduce immediate operating expenses for firms, but they may also encourage higher energy consumption and weaken incentives to improve energy efficiency [3]. Therefore, maintaining low fuel prices through broad subsidies may not necessarily produce an efficient industrial logistics system. A more targeted approach can potentially provide necessary cost support while maintaining incentives for firms to improve energy use.

The role of targeted subsidy management becomes increasingly important in this situation. Targeted subsidies can be directed toward users, sectors, or activities that have strategic economic importance and significant exposure to energy costs. This approach may reduce the fiscal burden associated with generalized subsidies while ensuring that critical logistics activities continue to receive appropriate support. Previous research concerning transportation and maritime logistics subsidies demonstrates that government intervention can influence transportation costs and regional price structures [10], [12].

The results also indicate that fuel subsidy policy should be integrated with logistics cost management. National logistics costs involve multiple components, and fuel is only one determinant of transportation expenditure. Infrastructure quality, route characteristics, distribution networks, transportation modes, and operational efficiency also influence logistics costs [5], [6], [13]. Therefore, targeted fuel subsidies will have a stronger impact when accompanied by improvements in transportation infrastructure and supply chain management.



Energy supply chain optimization provides another important consideration. Petroleum and LNG distribution systems require efficient network design, risk management, and transportation planning [8], [9]. A subsidy policy that lowers fuel costs without addressing distribution inefficiencies may only reduce one component of total costs without improving the underlying structure of the supply chain. Conversely, integrating energy policy with logistics optimization can create opportunities to improve both cost efficiency and supply reliability.

The findings further indicate that subsidy management can influence industrial competitiveness. High logistics costs increase the resources required to move inputs and products, potentially reducing firms' ability to compete in domestic and international markets. Improving the efficiency of fuel allocation and transportation costs can therefore contribute to a more competitive industrial environment. However, the long-term objective should be to improve supply chain productivity rather than create permanent dependence on fuel subsidies.

From a policy perspective, targeted fuel subsidy management requires accurate identification of beneficiaries, reliable distribution systems, transparent monitoring, and coordination between energy and industrial policies. The policy should distinguish between productive and non-productive fuel consumption and prioritize activities that generate substantial economic and supply chain benefits. Such an approach can reduce the risk of subsidy leakage while directing public resources toward strategically important logistics activities.

From an industrial perspective, firms should not rely exclusively on fuel subsidies to manage logistics costs. Enterprises should simultaneously pursue route optimization, fuel-efficient transportation, improved load utilization, multimodal transportation, digital logistics monitoring, and other efficiency measures. In this way, subsidy support can function as a complementary instrument rather than a substitute for operational improvements.

Overall, the discussion confirms that streamlining energy supply chains requires an integrated approach. Targeted fuel subsidies can influence the cost architecture of industrial logistics, but their effectiveness depends on their interaction with transportation systems, energy consumption behavior, infrastructure, distribution networks, and supply chain management. This integrated perspective provides a stronger foundation for designing energy and logistics policies that support both industrial competitiveness and long-term efficiency.



5. Conclusions

Based on the findings of the systematic literature review, fuel subsidy management has important implications for industrial logistics because fuel prices influence transportation expenditure, energy consumption, distribution activities, and overall supply chain costs. Generalized fuel subsidies can reduce short-term cost pressure but may also encourage excessive energy consumption and reduce incentives for efficiency [3], [4].

Targeted fuel subsidy management provides an alternative approach by directing energy support toward users, sectors, or logistics activities that have significant economic importance. Such an approach can potentially reduce cost distortions while maintaining support for critical transportation and distribution activities. The literature also demonstrates that logistics efficiency depends on factors beyond fuel prices, including infrastructure, transportation networks, distribution systems, and supply chain optimization [5], [8], [9].

The main contribution of this study is the integration of energy policy and industrial logistics perspectives. Rather than treating fuel subsidies solely as a fiscal instrument, the study positions targeted fuel subsidy management as a potential component of industrial logistics cost management. The effectiveness of this approach depends on accurate targeting, effective monitoring, reliable distribution, and coordination with broader logistics and energy-efficiency policies.

Limitations and Suggestions

This study has several limitations. First, the analysis is based exclusively on secondary literature and therefore does not directly measure the effects of targeted fuel subsidy management on individual industrial firms. Second, the selected studies differ in geographical settings, research methods, industrial sectors, and definitions of logistics costs and subsidy mechanisms. These differences may limit direct comparison across studies. Third, empirical literature specifically connecting targeted fuel subsidies with industrial logistics cost architectures remains relatively limited.

Future research should conduct empirical and longitudinal studies to examine how changes in fuel subsidy mechanisms influence transportation costs, logistics expenditures, energy consumption, and industrial competitiveness. Comparative research across industries and regions can also identify sectors that are most sensitive to fuel price changes and therefore most suitable for targeted energy support. Further studies should examine the role of digital monitoring, beneficiary identification, logistics optimization, energy efficiency, and alternative fuels in improving the effectiveness of subsidy management.

For policymakers, fuel subsidies should be designed based on clear beneficiary criteria and integrated with national logistics and energy-efficiency strategies. For industrial



enterprises, subsidy support should be accompanied by operational improvements such as transportation optimization, fuel efficiency, route planning, and digital supply chain monitoring. Through this integrated approach, targeted fuel subsidy management can contribute to more efficient energy supply chains, lower logistics cost pressures, and stronger long-term industrial competitiveness.

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