engineering proceedings

MDPI

Proceeding Paper

Maritime Piracy as a Threat to Energy Security in Global Supply Chains †

Sonia Rozbiewska

Doctoral School, Maritime University of Szczecin, 70-500 Szczecin, Poland; sonia.rozbiewska@gmail.com

† Presented at the 3rd International Online Conference on Energies (IOCEN 2026), 12–15 May 2026; Available online: https://sciforum.net/event/IOCEN2026.

Abstract

This article examines maritime piracy as a non-traditional security threat to global energy supply chains, focusing on its impact on the stability and resilience of maritime energy transport. As a significant share of oil and liquefied natural gas is shipped through vulnerable sea routes, piracy poses risks that extend beyond regional crime to global economic and geopolitical consequences. Using a comparative case study methodology based on secondary data from the ICC International Maritime Bureau, IMO GISIS, and ReCAAP, the study analyzes four key regions—the Somali coast, the Gulf of Guinea, the Red Sea corridor, and the Strait of Malacca—representing distinct piracy threat profiles, and examines their effects on critical energy chokepoints and the resulting economic and strategic disruptions. Through selected case studies and a review of current mitigation strategies, the paper highlights the need for coordinated international efforts to protect maritime energy security.

Keywords: maritime piracy; energy security; global supply chains; maritime transport; critical energy infrastructure; chokepoints; shipping security; supply chain resilience; international maritime security; oil and LNG transportation

1. Introduction

Energy security is commonly understood as the uninterrupted availability of energy resources at an affordable price, ensuring the stable functioning of modern economies and societies [1]. In an increasingly interconnected world, this security depends heavily on global maritime supply chains, which serve as the primary arteries of international energy trade [2–4]. Approximately 80–90% of the world's traded oil and liquefied natural gas is transported by sea, making maritime routes and critical chokepoints essential to the continuity of global energy flows [2]. However, these routes remain vulnerable to maritime piracy, which extends beyond a purely criminal phenomenon and represents a broader geopolitical challenge. Piracy disrupts shipping operations, increases transportation costs, and heightens regional instability, thereby affecting global energy markets [5,6]. Maritime piracy constitutes a significant non-traditional security threat that undermines the stability, reliability, and resilience of global energy supply chains [7–9].

2. Conceptual and Legal Framework of Energy Security and Maritime Piracy

This section establishes the theoretical and legal foundations necessary to examine the relationship between maritime piracy and energy security in global supply chains. It

Check for updates

Academic Editor: Ben Mclellan

Published: 14 July 2026

Copyright: © 2026 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

first outlines the core concept of energy security and then presents the legal framework governing maritime piracy, providing a basis for the subsequent analysis.

2.1. Energy Security

Energy security is a multidimensional concept that has been defined by several international organizations, each emphasizing the need for stable and reliable access to energy resources. According to the International Energy Agency (IEA), energy security refers to the uninterrupted availability of energy sources at an affordable price, combining both long-term considerations of investment and supply with short-term resilience to sudden disruptions [10]. The United Nations (UN) frames energy security within the broader context of sustainable development, highlighting the importance of reliable energy access for economic growth, social well-being, and environmental protection [11]. Similarly, the European Union (EU) defines energy security as the ability to ensure a stable and continuous supply of energy while reducing vulnerability to external shocks and geopolitical risks [12,13]. The three institutional perspectives cited above—IEA, UN, and EU—were selected on the basis of their global normative authority and their complementary analytical emphases. The IEA definition is particularly relevant to the operational and market dimensions of maritime energy security, given the agency's focus on supply disruptions and short-term resilience. The UN framework situates energy security within the broader context of sustainable development, providing a long-term perspective that extends beyond logistics to encompass economic and environmental dimensions. The EU definition introduces the geopolitical dimension of external vulnerability and supply diversification, which is directly relevant to the analysis of piracy-prone corridors linking Europe with energy-producing regions. Together, these three frameworks provide a multi-dimensional conceptual foundation that captures the full range of energy security risks examined in this study. While alternative definitions exist—including those developed by national governments or energy companies—the institutional perspectives selected represent the most widely cited and internationally recognized frameworks in the academic literature on energy security. These perspectives converge around four key pillars of energy security: availability, accessibility, affordability, and sustainability. Availability concerns the physical presence of sufficient energy resources and infrastructure to meet demand. Accessibility refers to the secure and uninterrupted delivery of energy through reliable transport routes and supply chains. Affordability emphasizes stable and reasonable energy prices that do not hinder economic development. Sustainability incorporates environmental responsibility and the long-term viability of energy systems. In the context of global maritime energy transport, all four pillars are closely interconnected, as disruptions at sea—such as those caused by piracy—can simultaneously threaten supply continuity, increase costs, restrict access, and challenge the resilience of energy systems.

2.2. Definition of Maritime Piracy

Maritime piracy is defined in international law primarily through Article 101 of the United Nations Convention on the Law of the Sea (UNCLOS). According to this provision, piracy consists of illegal acts of violence, detention, or depredation committed for private ends by the crew or passengers of a private vessel and directed against another ship or aircraft on the high seas or in a place outside the jurisdiction of any state [14]. This definition emphasizes three key elements: the private nature of the act, the involvement of two vessels, and the geographical scope limited to international waters. A crucial legal distinction exists between piracy and armed robbery at sea. While piracy, as defined by UNCLOS, occurs on the high seas and falls under universal jurisdiction, armed robbery at sea takes place within a state's territorial waters and is therefore subject to national criminal law [15].

Although both phenomena involve similar tactics—such as hijacking, hostage-taking, or theft—the difference in legal classification has significant implications for enforcement, prosecution, and international cooperation [16]. In practice, many attacks on energy-related vessels occur in territorial waters, complicating response mechanisms and placing greater responsibility on coastal states.

Contemporary maritime piracy is geographically concentrated in several high-risk regions that overlap with strategically important energy transport routes [2]. The Gulf of Guinea is widely regarded as the most dangerous area in the world in terms of crew kidnappings and violent attacks, directly influencing oil exports from West Africa [17]. The Strait of Malacca, one of the busiest maritime corridors globally, plays a crucial role in the transport of oil and liquefied natural gas between the Middle East and East Asia, meaning that even low-intensity incidents can carry significant strategic consequences [18]. The Horn of Africa, particularly waters off the coast of Somalia, has historically demonstrated the capacity of piracy to disrupt global energy flows and trigger large-scale international naval operations [19]. More recently, the Red Sea has attracted increased attention due to its function as a key corridor linking the Mediterranean with the Indian Ocean, where security incidents pose direct risks to energy shipments moving between Europe and Asia [20]. These regional hotspots demonstrate that maritime piracy is not merely a localized criminal phenomenon but a structural threat embedded in global maritime logistics. Its legal complexity and close geographical proximity to critical energy routes underscore its importance as a non-traditional security challenge with far-reaching implications for the stability and resilience of global energy supply chains.

3. Maritime Piracy and Energy Transport Routes

Global energy security is closely linked to the uninterrupted functioning of maritime transport routes used by oil tankers and liquefied natural gas (LNG) carriers. A large proportion of internationally traded hydrocarbons is transported by specialized vessels that must pass through a limited number of strategic maritime chokepoints. These routes are inherently vulnerable to piracy and other security disruptions, creating systemic risks for global energy supply chains.

3.1. Oil and LNG Tanker Routes

Oil tankers and LNG carriers form the backbone of global energy logistics, linking production regions in the Middle East, West Africa, and the Americas with major consumption markets in Europe and Asia [20]. These vessels typically operate on fixed, high-density routes that are predictable and geographically constrained [21]. Their size, relatively low maneuverability, and high economic value make them attractive targets for piracy [22]. Tankers often sail at reduced speeds in congested waters, increasing their exposure to boarding attempts [22].

LNG carriers face additional safety concerns due to the hazardous nature of their cargo. Although modern LNG vessels are equipped with advanced safety systems, any attack or prolonged disruption can create cascading logistical effects, including port congestion, delivery delays, and regional supply shortages [23]. Because many importing countries rely heavily on seaborne energy deliveries—and over 70% of globally traded liquefied natural gas is transported by sea—even short interruptions can rapidly translate into domestic energy insecurity, financial penalties under tightly scheduled long-term contracts, and volatility in spot market prices [24]. Such disruptions may undermine contractual reliability in international energy trade, exposing import-dependent states to heightened economic and political pressure. In the long term, repeated security incidents can erode confidence in vulnerable maritime corridors and encourage governments and energy companies to

invest in alternative infrastructure, such as new terminals, storage facilities, and pipeline connections, in order to reduce strategic dependence on high-risk sea lanes [25,26].

In this article, the global shipping lanes map (Figure 1) provides a starting point for analyzing the threats posed by maritime piracy as a destabilizing factor in energy security in global supply chains. The map depicts the world's main shipping lanes connecting key energy production and consumption regions, including the Middle East, Europe, East Asia, and North America. Strategic shipping chokepoints such as the Red Sea, the Gulf of Aden, the Strait of Malacca, and areas around West Africa are of particular importance, as they are also regions at increased risk of maritime piracy.



Figure 1. Global maritime shipping routes. Source: Tympakianakis [27].

Disruptions on these routes can lead to delays in energy supply, increased transportation costs, and increased uncertainty in energy markets. Maritime piracy, often concentrated near key transit points, poses a real threat to the continuity of supply and energy security of countries dependent on imported raw materials. Analysis of the presented routes allows us to identify areas particularly vulnerable to disruptions and highlights the importance of international cooperation in protecting maritime infrastructure and securing global supply chains.

3.2. Strategic Maritime Chokepoints

The Strait of Hormuz is one of the most critical energy chokepoints in the world, serving as the primary outlet for oil exports from the Persian Gulf. A significant share of globally traded crude oil and LNG transits this narrow passage. Its geographic constraints and heavy traffic density create favorable conditions for asymmetric threats, including piracy and armed attacks. Any disruption in this strait can trigger immediate price volatility and force costly rerouting strategies. The Bab el-Mandeb connects the Red Sea with the Gulf of Aden and is essential for energy shipments moving between Europe and Asia. Its proximity to politically unstable regions increases exposure to piracy and maritime violence.

Closure or insecurity in this corridor forces vessels to reroute around the Cape of Good Hope, significantly extending transit times and operational costs. The Strait of Malacca is a vital artery for energy flows to East Asia. Its narrow channels and extremely high vessel density heighten the risk of piracy incidents and navigational disruptions. Even temporary slowdowns can propagate delays throughout regional supply chains. Figure 2 presents a global map of maritime oil transport chokepoints, along with flow directions and estimated daily transit volumes. The highest flows are concentrated in the Strait of Hormuz and the Strait of Malacca, highlighting their crucial role in the global energy distribution system.

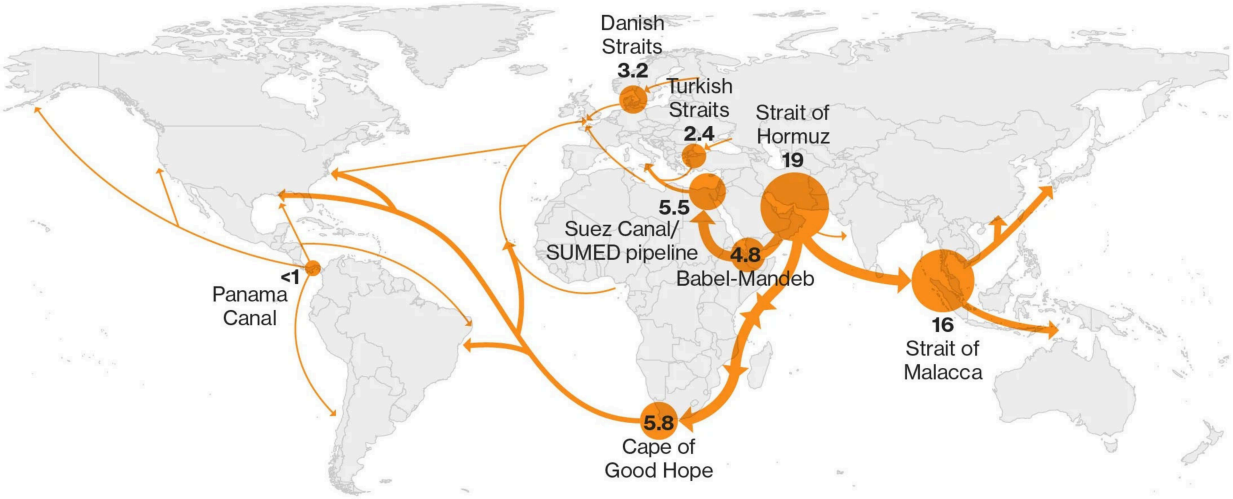

Figure 2. Daily transit volumes through world maritime oil chokepoints. Source: Bloomberg [28].

The map illustrates the high concentration of energy transport in several strategic points, whose vulnerability to disruptions poses a significant risk to the energy security of global supply chains. Any disruption at these chokepoints could trigger a domino effect, leading to logistical delays, increased transportation costs, and volatile energy markets.

3.3. Vulnerability of Tankers

Energy tankers are particularly vulnerable due to their operational characteristics. Their large size limits maneuverability, and their predictable routes allow attackers to anticipate transit patterns [29]. Additionally, tankers often operate with relatively small crews, reducing onboard defensive capacity [30]. The high economic value of both vessel and cargo creates strong incentives for criminal groups. In high-risk areas, the need to implement additional security measures—such as armed guards or rerouting—adds complexity and cost to operations [31].

3.4. Costs of Delays and Disruptions

Piracy-related delays generate significant economic consequences for global energy transport. Empirical studies estimate that rerouting vessels to avoid high-risk areas can extend voyages by 3000–6000 nautical miles, increasing fuel consumption by up to 20% and adding several hundred thousand US dollars to the cost of a single tanker journey [32]. Extended transit times also raise insurance premiums and charter rates, with some analyses indicating that piracy risk surcharges can increase total shipping costs by 5–10% in affected regions [33]. These logistical inefficiencies disrupt delivery schedules, create congestion at destination ports, and contribute to price volatility in global energy markets. As a result, the reliability of just-in-time supply systems is reduced, increasing the vulnerability of import-dependent economies to short-term supply shocks [34–36].

3.5. Risks to Offshore Energy Infrastructure

Beyond threats to vessels, piracy also poses risks to offshore energy infrastructure, including oil platforms, floating production units, and subsea installations [37]. Attacks on offshore facilities can interrupt production, endanger personnel, and damage critical equipment [38,39]. Such incidents may have long-term consequences for regional energy output and investor confidence [38]. Protecting offshore assets requires coordinated surveillance, naval presence, and cooperation between energy companies and maritime security authorities [38].

4. Economic and Strategic Impacts

Maritime piracy generates a wide range of economic and strategic consequences that extend far beyond individual shipping companies. For global energy supply chains, these impacts translate into higher operational costs, increased market uncertainty, and long-term shifts in trade patterns. The economic burden of piracy is distributed across shipowners, insurers, energy companies, and ultimately end consumers, while its strategic effects influence national security planning and international maritime cooperation.

4.1. Direct Economic Costs

The most immediate economic impact of maritime piracy is associated with direct financial losses. One of the most visible costs is the payment of ransoms following vessel hijackings [40]. Although ransom amounts vary by region and incident, documented cases have involved payments ranging from hundreds of thousands to several million US dollars per vessel [41]. Beyond the ransom itself, companies incur additional expenses related to negotiations, legal procedures, and operational downtime during captivity [42]. Insurance costs represent another major financial burden [43]. Ships transiting high-risk areas are subject to elevated war risk and kidnap-and-ransom insurance premiums [43]. In piracy-prone regions, these surcharges can substantially increase total voyage costs, particularly for high-value oil and LNG cargoes [43]. Insurers continuously reassess regional risk profiles, and sudden spikes in piracy activity can lead to rapid premium increases that affect the competitiveness of certain shipping routes [43]. Shipping companies also face rising security expenditures [44]. Protective measures include the employment of private armed guards, installation of physical barriers and surveillance equipment, and implementation of advanced tracking and communication systems [44]. While these measures enhance vessel safety, they add significant operational costs, especially for frequent transits through high-risk zones [44].

Finally, the need to reroute vessels to avoid insecure waters generates additional expenses. Alternative routes often involve longer distances, higher fuel consumption, and extended delivery times [20]. For energy shipments operating on tight schedules, such detours can disrupt supply contracts and reduce logistical efficiency [45]. Collectively, ransom payments, insurance surcharges, security investments, and rerouting costs illustrate how piracy imposes a measurable and persistent economic burden on global energy transport. Figure 3 summarizes the estimated relative weight of these four cost components. Insurance-related surcharges constitute the largest share of piracy-related operational costs (38%), followed by rerouting and additional fuel expenses (27%) and investments in protective security measures (21%), while ransom payments and the associated negotiation costs—although the most visible consequence of piracy—account for the smallest share (14%). This distribution indicates that the indirect and preventive costs of piracy substantially exceed the direct losses incurred through hijackings, underscoring the systemic rather than incidental character of the economic burden imposed on maritime energy transport.

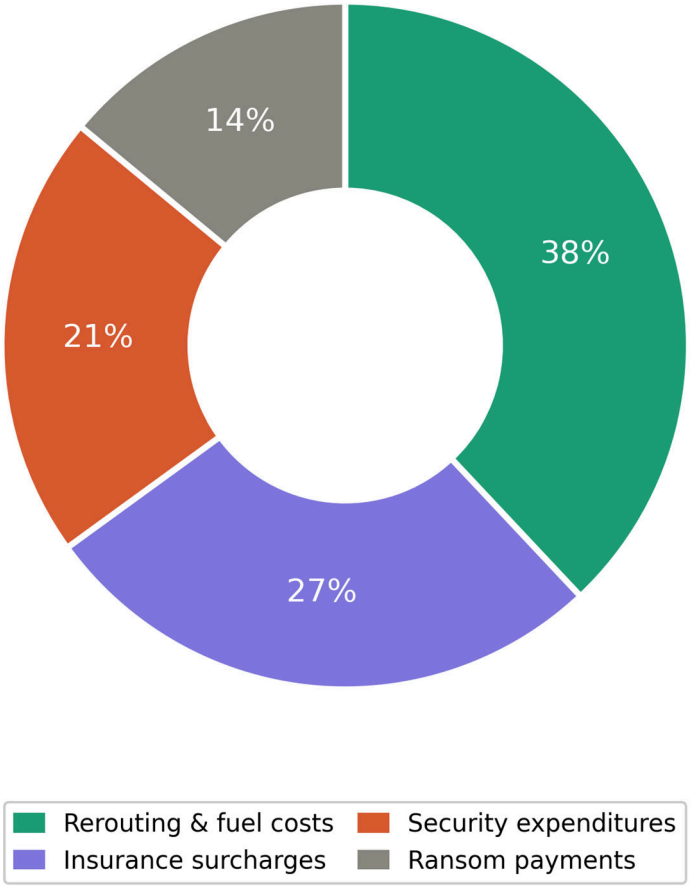

Figure 3. Estimated distribution of piracy-related operational costs in maritime energy transport: insurance surcharges (war risk and kidnap-and-ransom premiums, 27%), rerouting and additional fuel costs (38%), protective security measures (21%), and ransom payments with associated negotiation costs (14%). Author's own elaboration based on [32].

4.2. Market Volatility

Maritime piracy contributes to increased volatility in global energy markets by introducing uncertainty into the transport of oil and LNG [46]. Security incidents along key shipping routes can trigger short-term price fluctuations as markets react to the risk of supply disruptions and rising transportation costs [46]. Even the perception of heightened risk in strategic chokepoints may lead to speculative trading and temporary spikes in energy prices [47]. In the longer term, persistent insecurity discourages investment in vulnerable regions and offshore energy projects [47]. This investment uncertainty can slow infrastructure development and reduce the predictability of future supply, further amplifying market instability [47].

4.3. Geopolitical Consequences

Maritime piracy generates far-reaching geopolitical consequences by altering security arrangements along critical energy transport corridors [47,48]. A clear example is the multinational naval presence established in response to Somali piracy, including coordinated patrols by the European Union, NATO, and independent naval coalitions [48]. These missions, such as long-term escort operations in the Gulf of Aden, demonstrated how piracy can trigger sustained military engagement to safeguard oil and LNG shipments transiting between Europe and Asia [49]. Similar security initiatives have emerged in the Gulf of Guinea, where regional navies increasingly cooperate with international partners to protect offshore oil infrastructure and commercial vessels [50]. At the same time, anti-

piracy operations can reveal tensions between cooperation and strategic rivalry. Major naval powers often use maritime security missions to expand their operational presence in strategically important regions, which may raise concerns among neighboring states about sovereignty and influence [51]. In fragile coastal regions, piracy is closely linked to broader patterns of political instability, corruption, and economic underdevelopment [52]. Revenues from maritime crime can strengthen non-state armed groups and weaken government institutions, further destabilizing regions that are essential to global energy transport [49]. As a result, piracy not only threatens individual vessels but also contributes to complex geopolitical dynamics that shape the long-term security of international energy supply chains [49].

5. Research Methodology

This study adopts a comparative case study approach to examine how different forms of maritime piracy affect the resilience of global energy supply chains. The research design combines qualitative analysis of documented piracy incidents with a cross-regional comparison of their economic and strategic impacts on energy transport. By analyzing multiple regions characterized by distinct piracy profiles, the study seeks to identify recurring patterns as well as region-specific dynamics that shape energy security risks.

The selection of case studies was guided by three criteria: (1) strategic relevance to global oil and LNG transport routes, (2) diversity of piracy threat profiles, and (3) availability of reliable incident data for the period under study. Strategic relevance was operationalized as the presence of documented energy transport flows exceeding one million barrels per day through or adjacent to the region, based on data from the U.S. Energy Information Administration and IMO shipping statistics. Diversity of piracy threat profiles was assessed by reference to the IMB typology of incident types, encompassing hijacking, kidnapping-for-ransom, armed robbery, and opportunistic boarding, ensuring that the selected cases represent qualitatively distinct manifestations of maritime insecurity. Availability of reliable incident data was determined by the existence of systematic, multi-year reporting from at least one of the three primary international monitoring sources—IMB, GISIS, or ReCAAP. Regions such as the South China Sea and the Caribbean were considered but ultimately excluded: the South China Sea because incident profiles in the study period were predominantly low-severity and did not generate documented large-scale disruptions to energy transport comparable to the selected cases; the Caribbean because it does not constitute a primary corridor for global oil or LNG trade of equivalent strategic magnitude. The timeframes selected for each case study reflect the most analytically significant phase of piracy or maritime insecurity activity in each region, rather than a uniform calendar period. This approach prioritizes the internal validity of each case over strict temporal symmetry, in line with the qualitative comparative design adopted. Specifically, the 2023–2025 timeframe for Somalia was chosen to capture the documented resurgence of piracy following a prolonged period of suppression. The 2020–2025 period for the Gulf of Guinea reflects the chronic and structurally embedded nature of insecurity in that region, requiring a longer horizon to identify meaningful patterns. The 2023–2024 timeframe for the Red Sea corresponds to the acute and time-bounded disruption episode associated with Houthi-affiliated attacks. The 2020–2025 period for the Strait of Malacca enables assessment of a managed, persistent low-intensity risk environment over a medium-term horizon. Based on these criteria, four regions were selected: the Somali coast, the Gulf of Guinea, the Red Sea corridor, and the Strait of Malacca. Together, these cases represent a spectrum of maritime insecurity ranging from resurgence and chronic instability to acute geopolitical disruption and managed low-intensity risk. The empirical analysis relies primarily on secondary data from international maritime security databases and institutional

reports. Key sources include the ICC International Maritime Bureau (IMB) piracy reports, the IMO Global Integrated Shipping Information System (GISIS), and regional monitoring mechanisms such as ReCAAP. These datasets are supplemented by industry briefings and policy reports to contextualize operational and economic impacts. Given that the three primary data sources—IMB, GISIS, and ReCAAP—employ partially different classification systems and reporting categories, the data were not aggregated statistically. Instead, a qualitative standardization approach was applied, in which incidents from all sources were assessed against a common set of analytical categories: incident type, vessel category targeted, geographic location, operational disruption caused, and economic impact on energy transport. This approach is consistent with established practices in qualitative comparative research and ensures that cross-regional comparisons remain analytically valid without imposing artificial quantitative equivalence on data collected under different institutional frameworks. It should be acknowledged, however, that the primary data sources employed in this study carry inherent limitations that affect the interpretation of findings. First, all three monitoring systems—IMB, GISIS, and ReCAAP—are subject to underreporting, as shipping companies may choose not to report incidents to avoid reputational damage, increased insurance premiums, or administrative burden. This means that actual incident frequencies may be higher than those reflected in the data. Second, differences in classification methodologies between sources complicate direct comparison: IMB reports incidents occurring both on the high seas and in territorial waters, whereas UNCLOS-based definitions restrict piracy to international waters, meaning that armed robbery in territorial waters may be recorded differently across sources. Third, the distinction between piracy and politically motivated maritime violence—particularly relevant in the Red Sea case—is not consistently applied across institutional reporting frameworks, introducing potential ambiguity into cross-regional comparisons. These limitations are acknowledged as boundary conditions of the present analysis and do not invalidate the comparative framework, but they do counsel caution in the interpretation of specific quantitative indicators. While the study does not aim to produce statistical generalization, the comparative framework enables analytical generalization regarding the relationship between maritime piracy and energy supply chain vulnerability.

6. Case Studies

This section applies a comparative case study approach to examine how maritime piracy affects energy security across different strategic regions. Rather than providing extended historical narratives, each case study is structured to address a consistent set of analytical questions: the nature of the piracy threat, its impact on energy transport, and its broader economic and geopolitical consequences. This standardized framework enables a systematic comparison between regions and supports the identification of common patterns and region-specific dynamics. Each case study is organized into four analytical components: background context, key recent incidents within the selected time frame, the impact on energy transport systems, and the resulting regional and global implications. This structure ensures that the cases remain concise, empirically grounded, and directly linked to the article's central argument regarding the vulnerability of global energy supply chains to maritime piracy.

6.1. Case 1: Somali Piracy (2023–2025)

After nearly a decade of relative decline following intensive international counter-piracy operations, Somali piracy re-emerged as a significant security concern in 2023–2025. Reports from international monitoring systems, including IMO GISIS and industry security briefings, document a renewed pattern of hijacking attempts and armed boardings in

the Gulf of Aden and the western Indian Ocean. Several incidents involved commercial tankers transiting one of the world's most important energy corridors, highlighting the continued vulnerability of vessels carrying oil and petroleum products. To contextualize the significance of this resurgence, it is useful to compare the 2023–2025 figures with the historical peak of Somali piracy during the 2008–2012 period, when IMB recorded over 200 incidents annually and ransom payments reached hundreds of millions of dollars per year. While the current figures—approximately eight incidents in 2024 and four confirmed hijackings between December 2023 and mid-2024—represent a fraction of that peak activity, their strategic significance for energy transport cannot be assessed by volume alone. The reactivation of piracy networks capable of conducting open-ocean hijackings at distances of up to 900–1000 nautical miles from the Somali coast demonstrates a restoration of operational capability that, if left unchecked, carries the potential for rapid escalation. Historical evidence from the 2008–2012 period shows that Somali piracy scaled from isolated incidents to a systemic global shipping crisis within a period of approximately three years. The current resurgence therefore constitutes a significant early warning signal for energy transport security, warranting preventive international response disproportionate to current incident volumes. This resurgence demonstrates that piracy suppression is reversible when regional instability and reduced naval presence create opportunity structures for criminal groups. The renewed threat has had measurable implications for energy transport. Shipping companies responded by adjusting routing practices, increasing onboard security measures, and reassessing risk exposure in high-traffic areas near the Somali coast. Insurance providers reacted by revising war-risk premiums and security classifications for vessels operating in the region. Internationally, naval forces intensified patrol coordination and information sharing, underscoring the strategic importance of safeguarding this corridor. The Somali case illustrates how even a limited resurgence of piracy can disrupt confidence in critical maritime routes and impose additional costs on global energy logistics. It supports the broader argument that even suppressed piracy can rapidly re-emerge and destabilize energy corridors with regional and global consequences.

To summarize the key characteristics of the Somali piracy resurgence and its implications for energy transport, Table 1 presents the most important quantitative indicators and operational features observed in 2023–2025. The quantitative data presented in this case study are based on official statistics from the ICC International Maritime Bureau (IMB), including the IMB Piracy and Armed Robbery Against Ships Annual Report 2023 [53], the IMB Annual Report 2024 [54], and the IMB Quarterly Reports 2024–2025 [55]. These reports provide systematically collected global incident data on piracy and armed robbery against ships, including information on incident frequency, vessel types involved, geographic distribution, and impacts on crews. They constitute one of the primary international reference sources for empirical analysis of contemporary maritime piracy trends. The table synthesizes incident data, geographic scope, and security responses in a comparative format that supports further analysis of regional energy security risks.

Table 1. Key indicators of Somali piracy resurgence (2023–2025). Author's own elaboration.

Category	Indicator	Value/Evidence (2023–2025)	Relevance for Energy Security
Activity resurgence	First successful hijacking since decline period	December 2023—first confirmed commercial hijacking off Somalia since 2017	Signals reactivation of piracy networks in a key energy corridor
Incident frequency	Reported Somali-related incidents	~8 incidents in 2024; ~5 incidents in early 2025	Demonstrates sustained operational capability of pirate groups

Table 1. *Cont.*

Category	Indicator	Value/Evidence (2023–2025)	Relevance for Energy Security
Hijackings	Confirmed vessel hijackings	4 hijackings recorded between December 2023–mid 2024	Direct threat to tankers transiting Gulf of Aden
Operational range	Distance from Somali coast	Attacks reported up to ~900–1000 nautical miles offshore	Expands risk zone for energy shipping routes
Crew impact	Seafarers taken hostage	~25–30 crew members affected in early 2025 incidents	Raises insurance and security costs for tanker operators
Affected corridor	Strategic location	Gulf of Aden/Western Indian Ocean energy transit route	Middle East oil exports and Europe/Asia
Industry response	Routing and onboard security	Increased armed guards and route adjustments	Higher operational costs for energy transport
Insurance impact	War-risk premiums	Reclassification of Somali waters as elevated-risk zones	Increased transport costs reflected in energy prices
International response	Naval operations	Intensified patrols by multinational forces (e.g., EUNAVFOR)	Demonstrates geopolitical importance of corridor stability

6.2. Case 2: Gulf of Guinea (2020–2025)

Unlike the episodic resurgence observed off Somalia, piracy and armed robbery in the Gulf of Guinea represent a persistent and structurally embedded security challenge affecting one of the world's most important offshore energy production regions. Between 2020 and 2025, international monitoring systems—including IMO GISIS and ICC International Maritime Bureau (IMB) reports—consistently identified the Gulf of Guinea as a global hotspot for crew kidnappings and violent attacks at sea. Many incidents occurred in proximity to offshore oil infrastructure and along tanker routes serving West African export terminals, directly linking maritime insecurity to regional energy supply chains. The concentration of kidnapping-for-ransom operations and armed boardings has had tangible consequences for energy transport. Oil tankers and service vessels operating near Nigeria and neighboring states have faced elevated security risks, prompting shipping companies to adopt reinforced protection measures and adjust operational patterns. Insurance markets responded with sustained high war-risk premiums for vessels entering the region, reflecting the perception of chronic insecurity. At the regional level, coastal states intensified cooperative maritime security initiatives and patrol operations, often supported by international partners. Nevertheless, the persistence of incidents demonstrates the difficulty of eliminating piracy in environments characterized by weak governance and entrenched criminal networks. The Gulf of Guinea case shows how long-term maritime insecurity can generate continuous cost pressures and operational uncertainty for energy exporters, reinforcing the vulnerability of global energy supply chains.

To summarize the key characteristics of maritime insecurity in the Gulf of Guinea and its implications for energy transport, Table 2 presents the principal quantitative indicators and operational features observed in 2020–2025. The data are compiled from ICC International Maritime Bureau annual and quarterly piracy reports and related international monitoring sources, which provide standardized statistics on incident frequency, attack types, and impacts on crews.

Table 2. Key indicators of maritime insecurity in the Gulf of Guinea (2020–2025). Author's own elaboration.

Category	Indicator	Value/Evidence (2020–2025)	Relevance for Energy Security
Regional status	Global hotspot ranking	Gulf of Guinea accounted for the majority of global crew kidnappings in 2020–2022	Concentrates risk in a major oil export region
Incident frequency	Reported regional incidents	Dozens of piracy/armed robbery incidents annually, with gradual decline after 2021 but persistent activity through 2025	Sustained operational risk for tankers and offshore vessels
Attack type	Kidnapping for ransom	Crew abductions remain a defining feature of regional piracy	Raises insurance and security costs for energy operators
Target profile	Affected vessel types	Tankers and offshore support vessels frequently targeted	Direct exposure of oil export logistics
Geographic scope	Operational area	Coastal waters of Nigeria and neighboring states, including offshore oil zones	Threat to terminals and offshore infrastructure
Crew impact	Hostage incidents	Repeated multi-crew kidnappings reported during the period	Increases human and financial risk in energy transport
Industry response	Security measures	Expanded use of armed escorts and private maritime security	Higher operating costs for exporters
Insurance impact	Risk premiums	Persistently elevated war-risk classifications for the region	Cost pass-through to global energy markets
Regional response	Cooperative patrols	Strengthened regional maritime security frameworks and joint operations	Reflects strategic importance of stabilizing exports

6.3. Case 3: Red Sea Corridor (2023–2024): Geopolitical Disruption and Its Supply Chain Equivalence to Piracy

Unlike the cases examined in the preceding sections, the maritime disruptions in the Red Sea corridor during 2023–2024 do not constitute piracy in the strict legal sense of UNCLOS Article 101. The attacks were primarily carried out by Houthi-affiliated armed groups acting with political and strategic objectives tied to the broader regional conflict, rather than for private financial gain. As such, they represent a form of state-sponsored asymmetric maritime warfare rather than commercially motivated criminal activity. However, the inclusion of this case in the comparative framework is analytically justified on the grounds of functional equivalence: regardless of the perpetrator's motivation or legal classification, the operational consequences for global energy supply chains were structurally identical to those produced by criminal piracy—namely elevated risk perception, large-scale route avoidance, increased insurance premiums, and systemic logistics disruptions. This boundary case therefore serves to demonstrate that the vulnerability of maritime energy transport extends beyond the threat of traditional piracy and encompasses a broader spectrum of maritime insecurity, including hybrid and geopolitical forms of disruption.

These distinctions have significant practical implications for the applicability of existing maritime security instruments. Anti-piracy legal frameworks, including UNCLOS provisions on universal jurisdiction and the SUA Convention (Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation), were designed

primarily to address non-state criminal actors operating for private gain. Their application to state-sponsored or quasi-state actors pursuing political objectives—such as Houthi forces operating under de facto governmental authority in parts of Yemen—raises complex questions of sovereign immunity, the laws of armed conflict, and the threshold between law enforcement and military response. Similarly, standard kidnap-and-ransom insurance policies, which are calibrated to criminal piracy scenarios involving negotiable ransom demands, are poorly suited to politically motivated attacks using missiles and drones, where the objective is disruption rather than financial extortion. Naval response mechanisms face analogous challenges: counter-piracy operations such as EUNAVFOR Atalanta operate under mandates designed for criminal interdiction rather than armed conflict, limiting their legal authority to engage state-affiliated armed groups. These gaps in the existing governance architecture underscore the need for adaptive legal and institutional frameworks capable of addressing the full spectrum of maritime threats to energy security.

The Red Sea corridor (including the Bab el-Mandeb Strait and approaches to the Suez Canal) became a focal point of maritime insecurity in 2023–2024, with direct consequences for global energy transport. While many incidents were not "classic" piracy in the UNCLOS sense, the operational outcome for energy supply chains was similar: elevated risk, route avoidance, higher costs, and uncertainty [56]. The impact on energy logistics was substantial. During the first two months of 2024, Suez Canal trade reportedly fell by around 50% year-on-year, reflecting large-scale rerouting away from the Red Sea corridor [57]. This diversion also affected energy flows: oil trade through the Bab el-Mandeb Strait averaged 4.0 million b/d in 2024 (through August) compared with 8.7 million b/d in full-year 2023 (Vortexa data cited by EIA) [58]. For ship operators, the main mitigation strategy was rerouting via the Cape of Good Hope, which increases transit times significantly—industry analysis notes rerouting can raise transit times by roughly 30% on key lanes [59]. The causal chain linking specific security incidents to these macroeconomic disruptions operates through several identifiable mechanisms. At the immediate level, individual attacks or credible threat announcements triggered risk reassessments by shipping companies, insurers, and flag state authorities, resulting in the rapid reclassification of the Red Sea corridor as a war-risk zone. This reclassification directly increased insurance premiums and activated contractual force majeure clauses, incentivizing large-scale voluntary rerouting even in the absence of actual vessel losses. At the operational level, the redirection of vessels around the Cape of Good Hope removed significant tanker capacity from the Red Sea corridor, creating a supply-demand imbalance in freight availability that further drove up charter rates. At the market level, the sustained reduction in Bab el-Mandeb oil flows—from 8.7 million barrels per day in 2023 to 4.0 million barrels per day in 2024—reduced the predictability of delivery schedules for European and Asian importers, increasing reliance on spot market purchases and contributing to price volatility. These mechanisms illustrate that the energy security impact of maritime insecurity is not limited to direct physical disruption but operates primarily through risk perception, contractual responses, and market anticipation of future supply constraints. Together, these dynamics show how a concentrated threat environment in a chokepoint can rapidly propagate delays, cost inflation, and risk premiums across energy supply chains.

To summarize the key characteristics of the Red Sea disruption and its implications for energy transport, Table 3 presents the most relevant quantitative indicators and operational features for 2023–2024, compiled from IMO situation updates and macro/energy-transport analyses.

Table 3. Key indicators of Red Sea maritime disruption (2023–2024). Author's own elaboration.

Category	Indicator	Value/Evidence (2023–2024)	Relevance for Energy Security
Incident environment	Recorded incidents affecting shipping	67 incidents recorded by IMO Secretariat	Confirms sustained threat conditions in a major energy corridor
Trade disruption	Suez Canal trade change	~50% drop in the first two months of 2024 vs. a year earlier	Indicates system-wide rerouting and reduced corridor reliability
Energy flow impact	Bab el-Mandeb oil flows	4.0 million b/d (2024 through Aug) vs. 8.7 million b/d (full-year 2023)	Demonstrates reduced oil transit through a critical chokepoint
Logistics response	Rerouting effect on transit time	Rerouting around Cape of Good Hope ≈ ~30% longer transit times (key lanes)	Higher freight costs, inventory strain, and delivery uncertainty
Cost transmission	Market & contract exposure	Higher insurance risk perception + longer voyages	Supports pass-through to energy prices and increased volatility (mechanism)

6.4. Case 4: Strait of Malacca (2020–2025)

The Strait of Malacca is one of the world's most critical maritime chokepoints for oil and liquefied natural gas transport, linking Middle Eastern energy exporters with major East Asian import markets. Between 2020 and 2025, international monitoring systems, including ICC International Maritime Bureau (IMB) and regional reporting mechanisms such as ReCAAP, consistently recorded a relatively high frequency of piracy and armed robbery incidents in the area. However, unlike high-intensity piracy zones, most incidents in the Strait of Malacca were characterized by low severity, typically involving opportunistic boarding and petty theft rather than vessel hijacking or prolonged crew detention. This distinction is crucial for assessing the actual impact on energy security. Despite persistent incident activity, large-scale disruptions to tanker traffic have remained rare. The majority of affected vessels were smaller commercial ships rather than large crude or LNG carriers, and most incidents did not interrupt voyages. This pattern reflects the effectiveness of sustained regional security cooperation among Indonesia, Malaysia, and Singapore, including coordinated patrols, surveillance initiatives, and information-sharing frameworks. Shipping companies operating in the corridor maintain preventive security practices, but widespread rerouting has generally been unnecessary due to the corridor's continued operational reliability.

From an energy security perspective, the Strait of Malacca illustrates a model of managed insecurity in which frequent low-level incidents coexist with stable large-scale energy transport. Insurance markets typically classify the area as requiring caution rather than as an extreme high-risk zone, helping to prevent excessive cost escalation. The Malacca case demonstrates that strong regional governance and cooperative security mechanisms can contain escalation and preserve the functionality of a critical energy chokepoint, even in the presence of persistent maritime crime. It provides an important counterpoint to crisis-driven cases by showing how institutional capacity can mitigate the systemic impact of piracy on global energy supply chains.

To summarize the operational characteristics of maritime security in the Strait of Malacca and their implications for energy transport, Table 4 presents the principal indicators observed in 2020–2025, compiled from IMB and ReCAAP incident statistics.

Table 4. Key indicators of maritime security in the Strait of Malacca (2020–2025). Author's own elaboration.

Category	Indicator	Value/Evidence (2020–2025)	Relevance for Energy Security
Incident profile	Frequency vs. severity	High frequency of low-severity armed robbery incidents	Limited disruption to major energy shipments
Attack characteristics	Typical incident type	Opportunistic boarding and petty theft	Minimal interruption of tanker operations
Target vessels	Affected ship categories	Predominantly small commercial vessels	Large energy carriers rarely hijacked
Governance framework	Regional cooperation	Coordinated patrols by Indonesia, Malaysia, and Singapore	Stabilizes a critical energy chokepoint
Industry response	Preventive practices	Routine vigilance and onboard security measures	Maintains corridor reliability
Insurance perception	Risk classification	Moderate caution zone rather than extreme high risk	Controls escalation of transport costs
System outcome	Operational continuity	No sustained large-scale rerouting observed	Supports stable energy supply flows

7. Discussion

The analysis presented in this article indicates that maritime piracy remains a significant and evolving threat to global energy supply chains. Although the intensity and geographic distribution of piracy fluctuate over time, recent developments in regions such as the Horn of Africa and the Red Sea demonstrate that maritime insecurity can quickly re-emerge and disrupt critical transport corridors. In an energy system that depends heavily on predictable maritime logistics, even localized incidents generate disproportionate systemic effects. Piracy therefore continues to represent a serious non-traditional security challenge, particularly for import-dependent economies that rely on uninterrupted seaborne deliveries of oil and liquefied natural gas.

7.1. Application of the Four-Pillar Energy Security Framework

The four pillars of energy security introduced in Section 2.1—availability, accessibility, affordability, and sustainability—provide a structured basis for comparing the energy security implications of maritime piracy across the four regional cases. The following paragraphs assess each pillar in turn, and the resulting disruption scores for the four cases are synthesized graphically in Figure 4 at the end of this section.

Availability—the physical continuity of energy supply—is most severely threatened in the Red Sea case, where oil flows through the Bab el-Mandeb Strait fell by more than 50 percent in 2024, and in the Somali case, where the reactivation of piracy networks threatens one of the primary corridors for Middle Eastern oil exports to Europe and Asia. In the Gulf of Guinea, availability risks are concentrated around offshore production infrastructure, where attacks on platforms and support vessels can directly interrupt regional oil output. In the Strait of Malacca, availability risks remain low due to effective regional governance, despite persistent low-level incident activity.

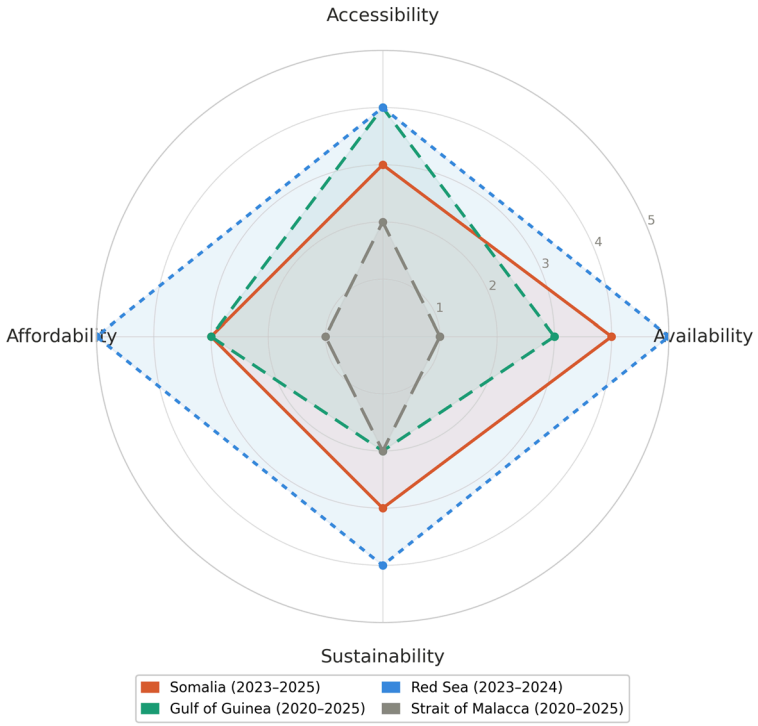

Figure 4. Impact of maritime insecurity on the four pillars of energy security by region (scale 1–5: 1 = minimal disruption, 5 = severe disruption). Author's own elaboration based on case study analysis.

Accessibility—the secure and uninterrupted delivery of energy through reliable transport routes—is compromised across all four cases, though to varying degrees. The Red Sea and Somali cases generate the most acute accessibility disruptions through large-scale rerouting and increased transit uncertainty. The Gulf of Guinea case creates chronic accessibility challenges for West African oil exporters, while the Strait of Malacca maintains relatively stable accessibility due to coordinated regional security mechanisms.

Affordability—the maintenance of stable and reasonable energy transport costs—is most visibly affected in the Red Sea case, where rerouting around the Cape of Good Hope increased freight costs significantly and contributed to spot market price volatility. In the Gulf of Guinea and Somali cases, persistently elevated war-risk insurance premiums and private security expenditures impose ongoing cost burdens on energy transport. The Strait of Malacca generates moderate and manageable cost pressures.

Sustainability—the long-term viability and resilience of energy systems—is affected across all cases through the erosion of investor confidence in vulnerable maritime corridors, the diversion of capital toward security expenditures rather than infrastructure development, and the potential acceleration of energy transition investments driven by supply insecurity. The Red Sea disruptions in particular have intensified discussions around supply chain diversification and multimodal alternatives, with potential long-term implications for the geography of global energy trade.

Building on this four-pillar assessment, the following discussion examines three broader systemic dimensions through which maritime piracy shapes global energy security: structural supply chain vulnerability, financial transmission mechanisms, and geopolitical reconfiguration.

First, piracy increases the structural vulnerability of energy supply chains by introducing persistent transport disruptions and logistical uncertainty. Energy shipping operates within tightly scheduled and highly interconnected networks in which even minor delays can propagate across multiple nodes, affecting storage levels, port operations, refinery

throughput, and downstream distribution systems. Because many energy supply chains function with limited buffer capacity and depend on synchronized tanker arrivals, disruptions in one segment can generate cascading effects throughout regional and global markets. Repeated incidents in strategic chokepoints undermine the reliability of established routes and force operators to adopt risk-averse strategies, including rerouting, speed adjustments, convoy sailing, and additional security procedures. These adaptations, while necessary to mitigate immediate threats, reduce overall system efficiency and increase operational complexity. Longer transit times strain fleet availability, complicate scheduling, and intensify pressure on port infrastructure already operating near capacity. For import-dependent countries, prolonged uncertainty in delivery schedules can weaken strategic reserves planning and increase reliance on spot market purchases. Over time, the normalization of security-driven adjustments reshapes logistical planning by embedding higher risk premiums and contingency margins into supply chain management. This process reveals the underlying fragility of global energy logistics in the face of maritime threats and underscores how piracy acts as a structural stressor that challenges the resilience, flexibility, and predictability of international energy transport systems.

Second, the financial burden associated with maritime security has measurable implications for global energy prices. Rising insurance premiums, private security expenditures, and longer transit routes increase operational costs for shipping companies and energy traders. These costs are frequently transferred along the supply chain and ultimately borne by consumers through higher energy prices. In volatile market conditions, the perception of increased maritime risk can amplify speculative behavior and price fluctuations. Consequently, piracy contributes not only to direct economic losses but also to broader market instability that affects energy affordability and investment planning. For energy-importing economies with limited domestic production, even marginal increases in transportation costs can significantly widen trade deficits and intensify inflationary pressures. Moreover, persistent security-related expenses may discourage long-term investment in vulnerable maritime regions, reducing infrastructure development and reinforcing structural inefficiencies in global energy markets.

Third, piracy contributes to the militarization of key maritime corridors, reshaping geopolitical dynamics around energy transport. The sustained presence of multinational naval forces in piracy-prone regions reflects the strategic importance of protecting energy flows. While such deployments enhance short-term security and promote international cooperation, they can also intensify competition for influence in strategically vital waterways. In politically fragile regions, the interaction between piracy, weak governance, and external military involvement may reinforce long-term instability. This evolving security architecture shows that maritime piracy is closely intertwined with broader geopolitical processes shaping the governance of global commons.

It should also be recognized that maritime insecurity creates adaptive incentives for non-Western actors that are not fully captured by analyses focused on Western-led naval responses. Disruptions to traditional chokepoints have accelerated interest in alternative multimodal transport corridors across Eurasia, including routes supported within the frameworks of the Shanghai Cooperation Organisation (SCO) and BRICS. China, as the world's largest importer of crude oil and LNG, has particular strategic interest in developing supply chain alternatives that reduce dependence on vulnerable maritime chokepoints dominated by Western naval presence. Similarly, disruptions in the Red Sea and the Strait of Hormuz have intensified discussions around overland pipeline connectivity and continental logistics networks linking Russia, Central Asia, the Middle East, and East Asia. While a detailed examination of these non-Western adaptive strategies lies beyond the scope of the present paper, their growing relevance to global energy logistics indicates that

future research should address the multipolar dimensions of maritime security governance, moving beyond the traditional focus on Western institutional responses.

Looking forward, the future of energy supply chains will be influenced by both persistent maritime risks and the ongoing global energy transition. Even as renewable energy expands, oil and LNG are expected to remain central to international trade for decades, sustaining the strategic relevance of maritime transport routes. At the same time, diversification of energy sources and supply chains may alter traffic patterns and redistribute security risks across regions. Emerging technologies in surveillance, automation, and risk management could improve the resilience of maritime logistics, but they are unlikely to eliminate piracy entirely. Instead, the challenge will be to integrate technological innovation, international cooperation, and regional capacity-building into a comprehensive framework for maritime energy security.

The radar diagram in Figure 4 reveals distinct risk profiles across the four regional cases. The Red Sea corridor emerges as the most severe threat to energy security across all four pillars, with particularly high scores on availability and affordability, reflecting the large-scale rerouting of vessels and the associated freight cost increases documented in 2023–2024. Somalia presents an elevated risk primarily in the availability dimension, consistent with the resurgence of hijacking activity along a critical oil transit corridor. The Gulf of Guinea displays the highest accessibility score among the four cases, reflecting the chronic disruption of offshore oil export logistics caused by persistent kidnapping-for-ransom operations. The Strait of Malacca stands apart as the only case in which all four pillars register low disruption scores, demonstrating that sustained regional governance and cooperative security mechanisms can preserve energy supply chain functionality even in the presence of frequent low-severity incidents. Taken together, the diagram illustrates that maritime insecurity does not affect energy security uniformly: its impact is shaped by the type of threat, the strategic importance of the corridor, and the effectiveness of regional response mechanisms.

7.2. Typology of Maritime Piracy Risk for Energy Supply Chains

Taken together, the four case studies suggest a synthetic typology of maritime piracy risk for energy supply chains (Table 5), ranging from resurgence risk (Somalia), through chronic structural insecurity (Gulf of Guinea) and acute geopolitical disruption (Red Sea), to managed low-intensity risk (Strait of Malacca). These categories differ not only in incident frequency but, more importantly, in their systemic impact on energy transport reliability, cost structures, and geopolitical stability. From a broader perspective, the persistence of diverse piracy risk profiles indicates that maritime insecurity will remain an embedded feature of global energy logistics. Ensuring resilient energy supply chains therefore requires integrating maritime security governance into long-term energy strategy, combining regional cooperation, risk diversification, and adaptive infrastructure planning. The legal classification of these threat categories and the corresponding response mechanisms are visualized in Figure 5.

The spectrum diagram in Figure 5 illustrates the fundamental distinctions between the four categories of maritime threat encountered across the case studies analyzed in this paper. Moving from left to right, the nature of the threat shifts along two axes simultaneously: severity of disruption increases, and the motivational basis transitions from private financial gain to political objective. Petty theft and armed robbery, characteristic of the Strait of Malacca and the Gulf of Guinea respectively, fall under national criminal law and are addressed through regional patrol mechanisms and private security measures. Classical piracy as defined under UNCLOS Article 101—exemplified by the Somali resurgence—occurs on the high seas and triggers universal jurisdiction, enabling multinational naval

responses such as EUNAVFOR and the CGPCS framework. Asymmetric warfare, represented by the Red Sea case, occupies a qualitatively distinct category: the perpetrators are quasi-state actors pursuing political rather than financial objectives, and the applicable legal frameworks—the laws of armed conflict and the SUA Convention—are structurally ill-suited to the operational reality. This typological distinction has direct implications for governance: no single legal instrument or response mechanism covers the entire spectrum, which is why the paper argues for adaptive, multipolar frameworks capable of addressing maritime insecurity in all its forms.

Table 5. Typology of maritime piracy risk for energy supply chains. Author's own elaboration.

Risk Type	Region	Threat Characteristics	Primary Impact Mechanism	Economic Consequences	Response Model
Resurgence risk	Somalia	Episodic reactivation of suppressed piracy networks	Route uncertainty, increased naval costs	Higher insurance premiums, rerouting costs	Multinational naval patrols, capacity-building
Chronic structural insecurity	Gulf of Guinea	Persistent, embedded criminal networks near offshore infrastructure	Continuous cost pressure, crew risk	Sustained war-risk premiums, security expenditures	Regional cooperative frameworks, armed escorts
Acute geopolitical disruption	Red Sea	State-sponsored asymmetric maritime warfare	Large-scale route avoidance, chokepoint closure	Sharp freight cost spikes, energy price volatility	Diplomatic engagement, naval deterrence
Managed low-intensity risk	Strait of Malacca	Frequent low-severity opportunistic incidents	Minimal direct disruption to major energy carriers	Moderate insurance classifications, routine security costs	Regional governance, coordinated patrols

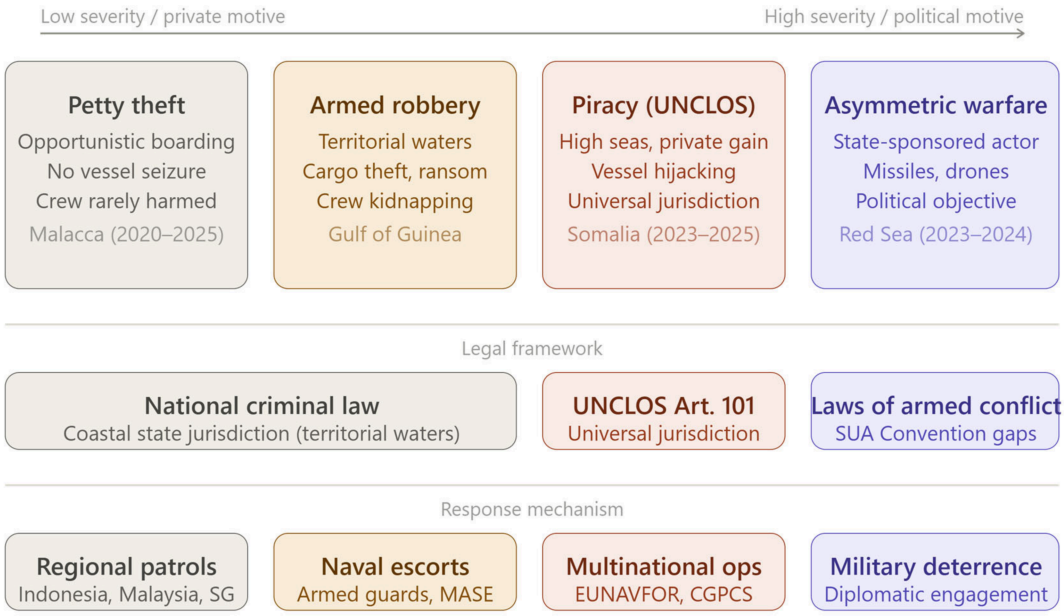

Figure 5. Spectrum of maritime threats to energy supply chains: legal classification and response mechanisms. Author's own elaboration based on UNCLOS Article 101 and SUA Convention.

8. Conclusions

Maritime piracy remains a destabilizing factor that directly affects the reliability and resilience of global energy supply chains. By disrupting transport routes, increasing operational costs, and intensifying geopolitical tensions, piracy exposes structural vulnerabilities in the maritime system that underpins international energy trade. Addressing these risks requires governance frameworks that move beyond general prescriptions toward specific and actionable institutional solutions. Models that have demonstrated effectiveness in

practice, such as the Contact Group on Piracy off the Coast of Somalia (CGPCS) and the EU Maritime Security Programme (MASE), provide replicable templates for multinational coordination combining naval operations with regional capacity-building. Similar mechanisms should be developed and strengthened for the Gulf of Guinea and the Red Sea corridor, with explicit inclusion of regional actors such as the African Union and ASEAN.

From a technological perspective, broader deployment of satellite-based Automatic Identification System (AIS) monitoring, maritime domain awareness (MDA) platforms, and machine learning-assisted anomaly detection in high-risk corridors can significantly enhance early warning capabilities and reduce response times to emerging threats.

From an energy policy perspective, supply chain resilience should be pursued on two complementary levels. In the short term, operational hedging instruments—including strategic petroleum reserves, flexible charter arrangements, and pre-negotiated rerouting protocols—can mitigate the immediate impact of maritime disruptions. In the long term, structural diversification through investment in new terminal infrastructure, multimodal logistics integration, and alternative supply corridors will reduce systemic dependence on vulnerable chokepoints. Critically, any effective governance framework must reflect the multipolar nature of contemporary maritime security and incorporate non-Western regional actors, moving beyond exclusive reliance on Western naval coalitions to ensure stable and affordable energy flows in an increasingly complex global environment.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data are contained within the article.

Conflicts of Interest: The author declares no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AIS	Automatic Identification System
ASEAN	Association of Southeast Asian Nations
BRICS	Brazil, Russia, India, China, South Africa
CGPCS	Contact Group on Piracy off the Coast of Somalia
EIA	Energy Information Administration
EU	European Union
EUNAVFOR	European Union Naval Force
GISIS	Global Integrated Shipping Information System
IEA	International Energy Agency
IMB	ICC International Maritime Bureau
IMO	International Maritime Organization
LNG	Liquefied Natural Gas
MASE	Maritime Security Programme
MDA	Maritime Domain Awareness
NATO	North Atlantic Treaty Organization
ReCAAP	Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia
SCO	Shanghai Cooperation Organisation
SUA	Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea

References

1. Strojny, J.; Krakowiak-Bal, A.; Knaga, J.; Kacorzyk, P. Energy Security: A Conceptual Overview. *Energies* **2023**, *16*, 5042. [CrossRef]
2. Smailis, G.; Paravantis, D.J. The Geopolitics of Global Maritime Energy Transportation: Chokepoints, Markets, Risks and Security. Master's Thesis, University of Piraeus, Athens, Greece, 2025.
3. Verschuur, J.; Koks, E.E.; Hall, J.W. Ports' Criticality in International Trade and Global Supply-Chains. *Nat. Commun.* **2022**, *13*, 4351. [CrossRef] [PubMed]
4. Menzel, A.; Otto, L. Connecting the Dots: Implications of the Intertwined Global Challenges to Maritime Security. In *Global Challenges in Maritime Security*; Otto, L., Ed.; Advanced Sciences and Technologies for Security Applications; Springer International Publishing: Cham, Switzerland, 2020; pp. 229–243.
5. Martins, V.M. Influence of Maritime Logistics on International Relations. *Katonai Logiszt.* **2025**, *33*, 70–85. [CrossRef]
6. Luft, G.; Korin, A. *Energy Security Challenges for the 21st Century: A Reference Handbook*; Bloomsbury Publishing: New York, NY, USA, 2009.
7. Gesami, B. A Brief Guide to Africa's Maritime Security. *SSRN Electron. J.* **2023**. [CrossRef]
8. Dabova, E.L. Non-Traditional Security Threats in the Border Areas: Terrorism, Piracy, Environmental Degradation in Southeast Asian Maritime Domain. *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci.* **2013**, *XL-4/W3*, 51–56. [CrossRef]
9. Mehmood, Z.H. AI, Information and Maritime Security: Implications for Global Trade and Geopolitical Competition. In *AI, Information, and Global Dynamics*; Roumate, F., Ed.; Contributions to International Relations; Springer Nature: Cham, Switzerland, 2026; pp. 137–156.
10. Schmitz, R.; Flachsbarth, F.; Plaga, L.S.; Braun, M.; Härtel, P. Energy Security and Resilience: Revisiting Concepts and Advancing Planning Perspectives for Transforming Integrated Energy Systems. *Energy Policy* **2025**, *207*, 114796. [CrossRef]
11. Karlsson-Vinkhuyzen, S.I. The UN, Energy and the Sustainable Development Goals. In *The Palgrave Handbook of the International Political Economy of Energy*; Van De Graaf, T., Sovacool, B.K., Ghosh, A., Kern, F., Klare, M.T., Eds.; Palgrave Macmillan: London, UK, 2016; pp. 115–138.
12. Li, Q.; Song, Z. Research on Energy Security in the EU from a Trade Perspective: A Historical Analysis from 1991 to 2021. *Energies* **2025**, *18*, 3801. [CrossRef]
13. Gökgöz, F.; Güvercin, M.T. Energy Security and Renewable Energy Efficiency in EU. *Renew. Sustain. Energy Rev.* **2018**, *96*, 226–239. [CrossRef]
14. United Nations. *United Nations Convention on the Law of the Sea (UNCLOS)*; United Nations Office of Legal Affairs: New York, NY, USA, 1982.
15. Satkauskas, R. Piracy at Sea and the Limits of International Law. *Aegean Rev. Law Sea Marit. Law* **2011**, *1*, 217–235. [CrossRef]
16. Sainchyn, O.; Hromova, M.; Gushchyn, O.; Legkikh, K. Specifics of the Legal Regulation of the Prevention of the Taking and Killing of Hostages in the Context of Terrorist Threats. *Secur. J.* **2022**, *35*, 1087–1101. [CrossRef]
17. Adesanya, O.P. Maritime Crimes and the Gulf of Guinea. *Cogent Soc. Sci.* **2023**, *9*, 2241263. [CrossRef]
18. Guo, F.; Huang, C.; Wu, X. Strategic Analysis on the Construction of New Energy Corridor China–Pakistan–Iran–Turkey. *Energy Rep.* **2019**, *5*, 828–841. [CrossRef]
19. Akar, Ç. The Development of Piracy in the Horn of Africa. *J. Mar. Eng. Technol. (JOINMET)* **2022**, *2*, 31–39. [CrossRef]
20. Rodriguez-Diaz, E.; Alcaide, J.I.; Garcia-Llave, R. Challenges and Security Risks in the Red Sea: Impact of Houthi Attacks on Maritime Traffic. *J. Mar. Sci. Eng.* **2024**, *12*, 1900. [CrossRef]
21. Parker, S. Matching in the Oil Tanker Industry: Implications for Energy Efficiency. Ph.D. Thesis, University College London (UCL), London, UK, 2014.
22. Jin, M.; Shi, W.; Lin, K.-C.; Li, K.X. Marine Piracy Prediction and Prevention: Policy Implications. *Mar. Policy* **2019**, *108*, 103528. [CrossRef]
23. Briouig, M. Risk Management in Liquefied Natural Gas Ports and Marine Terminals Supply Chains. Ph.D. Thesis, University of Plymouth, Plymouth, UK, 2014. [CrossRef] [PubMed]
24. Omale, O. *Seaborne Trade of Liquified Natural Gas*; Preprint; Cardiff University: Cardiff, UK, 2021. [CrossRef]
25. Badea, M.; Bucovețchi, O.; Gheorghe, A.V.; Hnatiuc, M.; Raicu, G. Maritime Industry Cybersecurity Threats in 2025: Advanced Persistent Threats (APTs), Hacktivism and Vulnerabilities. *Logistics* **2025**, *9*, 178. [CrossRef]
26. Shawe, R. The Crucial Role of Safeguarding Critical Infrastructure in Ensuring the Stability and Security of the U.S. Supply Chain. *Am. J. Ind. Bus. Manag.* **2025**, *15*, 1055–1071. [CrossRef]
27. Tympakianakis, P. Global Shipping Is Facing New Challenges 5 Years After COVID Disruption. 2025. Available online: https://www.linkedin.com/pulse/global-shipping-facing-new-challenges-5-years-after-tympakianakis-uvjrf (accessed on 1 July 2026).
28. Ulrichsen, K.C.; Krane, J. Maritime Chokepoints and Risks to Global Shipping and Energy Security. 2026. Available online: https://www.bakerinstitute.org/research/maritime-chokepoints-and-risks-global-shipping-and-energy-security (accessed on 1 July 2026).

29. Sharif, N.; Rönnqvist, M.; Cordeau, J.-F.; Audy, J.-F.; Warya, G.; Ngo, T. Multi-Objective Vessel Routing Problems with Safety Considerations: A Review. *Marit. Transp. Res.* **2024**, *7*, 100122. [CrossRef]
30. Xiao, Z.; Xu, L. A Study on Global Piracy Attacks' Trends and Characteristics Based on Data Analysis. *Int. J. Secur. Appl.* **2017**, *11*, 233–244.
31. Ewuola, A. Marine Security Risk Management in High-Risk Zones: Lessons from West African LNG Terminals. *Int. J. Adv. Multidiscip. Res. Stud.* **2023**, *3*, 1770–1779. [CrossRef]
32. Kalinichenko, Y.; Vasalatii, N.; Rossomakha, O.; Koliesnik, O.; Sagaydak, O.; Santana, L.O.; Zaiets, A.; Tomchakovsky, G.; Dolynska, N.; Holovan, A. *Some Issues of Increasing the Energy Efficiency of Ships by Improving Navigation Methods: Monograph*; Scientific Route OÜ: Tallinn, Estonia, 2025.
33. Ferrari, E.; Christidis, P.; Bolsi, P. The Impact of Rising Maritime Transport Costs on International Trade: Estimation Using a Multi-Region General Equilibrium Model. *Transp. Res. Interdiscip. Perspect.* **2023**, *22*, 100985. [CrossRef]
34. Jiang, B.; Rigobon, D.; Rigobon, R. From Just-in-Time, to Just-in-Case, to Just-in-Worst-Case: Simple Models of a Global Supply Chain under Uncertain Aggregate Shocks. *IMF Econ. Rev.* **2022**, *70*, 141–184. [CrossRef]
35. Lin, C.-W.R.; Lai, Y.S.; Jeng, S.-Y.; Nguyen, T.T.V.; Lim, M.K. Supply Chain Disruption Indicators: Vulnerability and Resilience in the Garment Industry in Vietnam. *Clean. Responsible Consum.* **2025**, *16*, 100251. [CrossRef]
36. Wanzala, R.W.; Obokoh, L.O. Sustainability Implications of Commodity Price Shocks and Commodity Dependence in Selected Sub-Saharan Countries. *Sustainability* **2024**, *16*, 8928. [CrossRef]
37. Asariotis, R.; Benamara, H.; Lavelle, J.; Premti, A. Maritime piracy: Part I: An overview of trends, costs and trade-related implications. In Proceedings of the United Nations Conference on Trade and Development, Geneva, Switzerland, 23 September 2014.
38. Bueger, C.; Stockbruegger, J. Oceans, Objects, and Infrastructures: Making Modern Piracy. *Glob. Stud. Q.* **2024**, *4*, ksae063. [CrossRef]
39. Bueger, C.; Liebetrau, T. Critical Maritime Infrastructure Protection: What's the Trouble? *Mar. Policy* **2023**, *155*, 105772. [CrossRef]
40. Mbekeani, K.K.; Ncube, M. Economic Impact of Maritime Piracy. *Afr. Econ. Brief* **2011**, *2*, 1–8.
41. Financial Action Task Force (FATF). *Organised Maritime Piracy and Related Kidnapping for Ransom*; FATF: Paris, France, 2011.
42. Fotini, P. The Asymmetric Cost Behavior of Operating Expenses in Shipping Companies. Master's Thesis, University of Piraeus, Piraeus, Greece, 2024.
43. Bendekovic, J.; Vuletic, D. Piracy Influence on the Shipowners and Insurance Companies. In *DAAAM International Scientific Book*; Katalinic, B., Tekic, Z., Eds.; DAAAM International: Vienna, Austria, 2013; Volume 12, pp. 711–718.
44. Sambu, E. Maritime Safety and Security: The Potential Role of Private Security Companies. *J. Marit. Sci. Technol.* **2025**, *1*, 1–9. [CrossRef]
45. Zis, T.P.V. The Enhanced Role of Canals and Route Choice Due to Disruptions in Maritime Operations. *Marit. Bus. Rev.* **2024**, *9*, 98–112. [CrossRef]
46. Morão, H. The Economic Effects of Tensions in Energy Transportation. *Res. Transp. Econ.* **2025**, *112*, 101598. [CrossRef]
47. He, Z.; Wang, C.; Gao, J.; Xie, Y. Assessment of Global Shipping Risk Caused by Maritime Piracy. *Heliyon* **2023**, *9*, e20988. [CrossRef] [PubMed]
48. Jin, J.; Techera, E. Strengthening Universal Jurisdiction for Maritime Piracy Trials to Enhance a Sustainable Anti-Piracy Legal System for Community Interests. *Sustainability* **2021**, *13*, 7268. [CrossRef]
49. Wang, X.; Du, D.; Peng, Y. Assessing the Importance of the Marine Chokepoint: Evidence from Tracking the Global Marine Traffic. *Sustainability* **2023**, *16*, 384. [CrossRef]
50. Ofosu-Boateng, N.R.L. Piracy in the Gulf of Guinea: Impacts to Maritime Transportation and Maritime Security. *J. Asian Dev.* **2018**, *4*, 1. [CrossRef]
51. Bradford, J.; Manicom, J.; Simon, S.W.; Quartaro, N.A. *Maritime Security in Southeast Asia: U.S., Japanese, Regional, and Industry Strategies*; NBR Special Report; The National Bureau of Asian Research: Seattle, WA, USA, 2010.
52. Chen, Q.; Zhang, H.; Lau, Y.; Liu, K.; Ng, A.K.Y.; Chen, W.; Liao, Q.; Dulebenets, M.A. A Geographic Information System (GIS)-Based Investigation of Spatiotemporal Characteristics of Pirate Attacks in the Maritime Industry. *J. Mar. Sci. Eng.* **2023**, *11*, 2295. [CrossRef]
53. ICC International Maritime Bureau (IMB). *Piracy and Armed Robbery Against Ships*; Annual Report; IMB: London, UK, 2023.
54. ICC International Maritime Bureau (IMB). *Annual Report 2024*; IMB: London, UK, 2024.
55. ICC International Maritime Bureau (IMB). *Quarterly Piracy and Armed Robbery Reports 2024–2025*; IMB: London, UK, 2024.
56. International Maritime Organization. *Red Sea Incidents Report for Member States*; International Maritime Organization: London, UK, 2024.
57. International Monetary Fund. Red Sea Attacks Disrupt Global Trade. 2024. Available online: https://www.imf.org/en/blogs/articles/2024/03/07/red-sea-attacks-disrupt-global-trade (accessed on 1 July 2026).

58. U.S. Energy Information Administration. Red Sea Attacks Disrupt Energy Markets and Shipping. 2024. Available online: https://www.eia.gov/todayinenergy/detail.php?id=61363 (accessed on 1 July 2026).
59. JP Morgan Chase & Co. *Red Sea Shipping Insights: Impact on Global Supply Chains*; J.P. Morgan Global Research: New York, NY, USA, 2024.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.